Michigan Transportation Asset Management Council

Meeting Agenda

Wednesday, December 5, 2018 @ 1:00 PM
Aeronautics Building – 2nd Floor Commission Room
2700 Port Lansing Rd., Lansing, MI

1. Welcome - Call to Order – Introductions

2. Changes or Additions to the Agenda (*Action Item as needed*) *Any items under the Consent Agenda may be moved to the regular agenda upon request of any Council member, member of the public or staff member.*

3. Public Comments on Non-Agenda Item

4. Consent Agenda (Action Item)

4.1. Approval of the November 7, 2018 Meeting Minutes ***(Attachment 1)***
4.2. TAMC Financial Report ***(Attachment 2)***

5. Presentations

5.1. TAMC Service Award Presentation to Donald Disselkoen
5.2. 2018 Michigan Local Agency Pavement Treatment Life Study – *Michigan Technological University-Center for Technology and Training (MTU-CTT)* ***(Attachment 3)***
5.3. Analysis of TAMC Investment Reporting Data for Network Level Modeling on the Locally Owned Road System in Michigan – *MTU-CTT* ***(Attachment 4)***

6. Michigan Infrastructure Council Update - *Johnson*

7. Old Business

7.1. TAMC Work Program Update – *Kent* ***(Attachment 5)***

8. Committee Review & Discussion Items

8.1. Data Committee – *McEntee*
8.1.1. IRT-ADARS Compliance Report – *Belknap*
8.1.2. Status of 2018 PASER Data Collection – *Belknap* ***(Attachment 6)***
8.1.3. Asset Management Plan Template Update and TAMC Plan Submittal Process – *McEntee/Start/Belknap*

8.2. ACE Committee – *Start*
8.2.1. TAMC Data Sharing Policy Update – *Start* ***(Attachment 7) (Action Item)***
8.2.2. TAMC Policy for the Collection of Roadway Surface Conditions – *Start* ***(Attachment 8) (Action Item)***
8.2.3. FY2020 TAMC Budget Update – *Start*
8.2.4. Training Schedule Update - TAMC Members Participation – *Jennett*

8.3. Michigan Center for Shared Solutions – *Surber/Holmes*

8.4. Michigan Technological University/Technical Assistance – *Colling*
8.4.1. Monthly Training Report (Sept/Oct) ***(Attachment 9)***
8.4.2. Monthly Activities Report (Sept/Oct) ***(Attachment 10)***

9. Public Comments

10. Member Comments

11. Adjournment: *Next meeting January 9, 2019 at 1:00 PM – Aeronautics 2nd Floor Commission Room, 2700 Port Lansing Rd., Lansing, MI*

Meeting Telephone Conference Line: 1-877-336-1828 Access Code: 8553654#

TRANSPORTATION ASSET MANAGEMENT COUNCIL
November 7, 2018 at 1:00 p.m.
MDOT Aeronautics Building, 2nd Floor Commission Room
2700 Port Lansing Road
Lansing, Michigan
MINUTES

**** Frequently Used Acronyms List attached**

Members Present:
Derek Bradshaw, MAR/GLS Region V
Bill McEntee, CRA – Vice-Chair
Bob Slattery, MML
Rob Surber, DTMB/CSS
Brad Wieferich, MDOT
Joanna Johnson, CRA/RCKC – Chair
Gary Mekjian, MML
Jonathan Start, MTPA/KATS
Jennifer Tubbs, MTA

Support Staff Present:
Roger Belknap, MDOT
Mark Holmes, DTMB/CSS
Tim Colling, MTU
Gloria Strong, MDOT

Public Present:
Jessica Moy, MI Dept. of Treasury/MIC

Members Absent:
Don Disselkoen, MAC

1. Welcome – Call-To-Order:
The meeting was called-to-order at 1:07 p.m. Everyone was welcomed and introduced. Jessica Moy was welcomed to the meeting. She is an employee of the Michigan Department of Treasury and the Executive Director for the Michigan Infrastructure Council.

2. Changes or Additions to the Agenda (Action Item):
None

3. Public Comments on Non-Agenda Items:
None

4. Consent Agenda (Action Item):

4.1. – Approval of the September 5, 2018 Meeting Minutes (Attachment 1)

Motion: J. Start made a motion to approve the September 5, 2018 Meeting Minutes; G. Mekjian seconded the motion. The motion was approved by all members present.

4.2. – Forbes Report: Michigan Infrastructure Plan Article (Attachment 2)
A copy of the article was shared with the Council.

4.3. – Press Release – TAMC Receives Special Tribute from Governor Rick Snyder (Attachment 3)
The award received on October 23, 2018 at the TAMC Annual Fall Conference by the Council from Governor Rick Snyder for their work on the Culvert Pilot Project was shown. A press release has been distributed. A copy will be made for each of the Council members to display in their offices.

4.4. – Press Release – WAMC Membership Announcement (Attachment 4)
A copy of the September 28, 2018 WAMC press release regarding "*Michigan Infrastructure Council Announces Appointment of Water Asset Management Council Members"* was shared with the Council.

Action Item: R. Belknap will make copies of the Culvert Pilot Project Award received from the Governor for all of the Council members and distribute at the next full Council meeting in December.

5. TAMC Budget Update:

5.1. – TAMC Financial Report (Attachment 5)
R. Belknap provided an updated financial report (November 2, 2018) for the Council's review. The MTU budget shown under line item #5 includes the culvert pilot Project expenses. J. Johnson requested that the MTU TAMC activities budget be separated out from the culvert project activities budget. The full allocation from the culvert project has been used.

Motion: J. Start made a motion to accept the financial report as provided; B. Slattery seconded the motion. The motion was approved by all members present.

Action Item: R. Belknap will separate the culvert project activities budget from the MTU regular TAMC activities budget on the next financial report and provide at the next full Council meeting in December.

5.2. – Michigan Technological University FY 2018 TAMC Activities Contract Modification Request – J. Start
MTU had a line item for the culvert pilot project for $150,000. Under line item 5 of the November 2, 2018 TAMC Budget Expenditure Report, under TAMC Activities the $265,000 in that budget includes the $150,000 MTU culvert project expenditures. As part of the year end work, as the final invoices are coming in, MTU provided a listing of the culvert pilot expenses and they exceeded the $150,000 by $22,100. They have requested an increase to cover the overage and it is recommended by the TAMC ACE Committee to approve the additional $22,100 from the TAMC Administrative Contingency Funds.

Motion: J. Start made a motion to approve the additional $22,100 be given from the TAMC Administrative Contingency Funds to MTU for the expense overage that they had for their work on the Culvert Pilot Project. MTU's contract will need to be modified in order for them to receive the additional funds; B. McEntee seconded the motion. The motion was approved by all members present.

5.3. – Northeast Michigan Council of Governments FY 2018 Asset Management Contract Modification Request – J. Start/R. Belknap
The Northeast Michigan Council of Governments (NEMCOG) has expended their entire FY 2018 Asset Management program allocation of $46,000 as of August 2018. They estimated that another $6,200 would be needed to cover September 2018 expenses. The request is to increase by $6,200 because they over ran the data collection budget for various reasons. Funding for this allocation increase would come from unspent FY 2018 TAMC budget line items. TAMC ACE Committee recommends approval of the increase to cover the overage however, they suggest that in the future, when TAMC has any unspent funds remaining, TAMC open it up to all agencies in August that any agencies in need of additional funds provide their reasoning and the funds be provided on a first come/first served basis. The TAMC ACE Committee will look at this in further detail in the future and make some decisions on how to approve/disapprove addition funding for agencies.

Motion: R. Slattery made a motion to approve the additional funds be given to NEMCOG from the FY 2018 TAMC remaining funds; D. Bradshaw seconded the motion. NEMCOGs contract will need to be modified in order for them to receive the additional funds. The motion was approved by all members present.

Action Item: R. Belknap will make the necessary modifications to MTUs and NEMCOGs contracts to assure they received the approved additional funds.

6. - Old Business:

TAMC Work Program Update – R. Belknap (Attachment 6)

A copy of the updated TAMC Work Program was provided and reviewed. The Council requested that the work program now include a column for MIC and WAMC. The Council would like the Top 123 agencies be consistent throughout the document. Also, add "100 or more certified miles" on the document showing that the 123 agencies have 100 or more certified miles. MDOT will be included as one of the Top 123.

7. – Michigan Infrastructure Council (MIC) Update – J. Johnson/J. Moy

A copy of the MIC Website https://www.michigan.gov/mic/ was provided to the Council members. They are encouraged to go out and review the Website. J. Moy informed the Council that TAMC will have a standing place on the MIC agenda to give updates and to collaborate and coordinate anything necessary with the MIC. The MIC is currently working on goals, bylaws, communications, and working through the logistics to get the MIC up and running.

8. Committee Reviews and Discussion Items:

8.1. – Data Committee – B. McEntee

8.1.1. – Planning Methods for Creating Schedule of Asset Management Plan Submittals of Top 123 Agencies – B. McEntee

Agencies are concerned about volunteering to be in Group 1 and what will be required of them and staffing issues they may have in order to create the asset management plan. Some agencies do not have staff to cover the traffic signal requirements. TAMC is not allowed to give them a cash incentive. The last approved asset management plan is not due until October 1, 2024. Any agency volunteering to be in Group 1 will have a longer time to get their plan into compliance.

Motion: J. Tubbs made a motion to start off at the bottom of the top 123 agencies alphabetized listing counting off at 1,2,3, That will choose which agencies will be in Groups 1, 2 or 3. TAMC will leave it open for any agency that wishes to volunteer for the first round; B. Slattery seconded the motion. The motion was approved by all members present. TAMC will do the count and send out a letter of communication to the top 123 agencies showing them who will be in Groups 1,2, or 3. It will also indicate the opportunity for those not chosen for Group 1 to volunteer to be in Group 1.

WAMC also has an asset management plan requirement but they do not have a plan on how to get that requirement completed as of yet. They may need to coordinate with TAMC. The same agencies may be chosen to do a TAMC and a WAMC asset management plan. Others will not have to do two plans because some agencies do not manage water assets.

8.1.2. – IRT/ADARS Compliance Report – R. Belknap

Agencies continue to do well on their entries. Recently, there has been well over 100 submittals. Currently, staff is not checking for future plan projects that are part of the three-year plan requirement. Should they be checking for compliance of this? The Council has asked that Data Committee review this and how to get this accomplished. It may be something as simple as changing the text. This information must be submitted at the budget level in the IRT.

Action Item: Data Committee has been tasked with figuring out how to check for future plan projects that are part of the three-year plan requirement.

8.1.3. – Status of 2018 PASER Data Collection – R. Belknap
R. Belknap gave a brief update on the 2018 PASER data collection. Collection is going well.

PASER and Quality Control (QC) – Chan Singh, MDOT staff who previously did the PASER ratings has retired. MDOT has now hired a contractor to do the PASER ratings and QC. J. Johnson reminded the Council that Mike Toth of MDOT offered to have the new contractor attend a TAMC full council meeting to give a brief report on their strategy.

Action Item: J. Johnson requested that the new MDOT QC contractor provide a brief update after their work has been completed on how things are going at the February 2019 TAMC meeting. R. Belknap will add this to the agenda.

8.2. – ACE Committee – J. Start

8.2.1. – TAMC Data Sharing Policy Update – J. Start
The ACE Committee was tasked by the TAMC full Council to pull together a Data Sharing Policy. A draft has been created and the ACE Committee has renamed it to the TAMC Public Data Sharing Policy. A copy of the revised draft will be provided to full Council at the December meeting for their review and approval.

Action Item: ACE Committee will provide a final draft of the Public Data Sharing Policy at the December full Council meeting.

8.2.2. – TAMP Template Update – T. Colling
MTU has created a TAMP template and it will be ready by the upcoming December trainings. There is a template for roads and bridges and it migrates out of Roadsoft. It is a one button push that sends it to the boilerplate, which would then give the agency about a 90% complete asset management plan. This has been tested in Roadsoft. Some items not covered but that can be added in the future are risk analysis, culverts, and signals. MTU will put together a list of questions to TAMC on how they would like certain issues that may arise handled and give them to Data Committee for review prior to coming to full Council. MTU will let the agencies know that this is new to everyone and TAMC will work closely with them to assure they get it completed correctly based upon the requirements of PA 325.

Action Item: MTU will put together a list of questions to TAMC on how they would like certain issues that may arise handled and give them to Data Committee for review prior to coming to full Council.

8.2.3. – Training Schedule Update, TAMC Participation – R. Belknap
CSS and MTU have created a schedule to hold IRT/PASER trainings. A copy of that schedule has been provided. Council members were encouraged to sign up to participate at the trainings. There are six other trainings that are currently being scheduled and MTU will provide those dates and locations at the next full Council meeting in December.

Action Item: MTU will provide additional training dates at the December full Council meeting.

8.2.4. – Other Items Discussed at ACE Committee Meeting – J. Start

G. Strong gave an update on the efforts to hold the TAMC Spring conference in Gaylord, Michigan in collaboration with APWA May 2019. If the conference plans are permissible, she will go ahead and block rooms for TAMC attendees at the TreeTop Resort. More to come.

D. Jennett gave the committee the timeline for the annual report and shared a draft of the "Year in Review" chapter of the report recently drafted by Christian Zimmer.

8.3. - Bridge Committee Update – J. Johnson/B. McEntee/B. Wieferich/T. Colling

8.3.1. - Update on the Culvert Pilot Project – MTU

An abbreviated summarized culvert report was created by Rebecca Curtis and a copy was distributed to the Council.

8.3.2. – Culvert Pilot Project Report Next Steps – T. Colling

TAMC does not have a budget for culvert activities. TAMC will need to consider how to fit this into the budget. TAMC will also need to look at how they will use the culvert data that they collected and if they want the culvert data that other agencies have collected.

8.4. – Michigan Center for Shared Solutions – M. Holmes

The Maintenance, Safety, and Traffic dashboards are being finalized. CSS is working on the analysis and doing dashboard changes that were requested by Data Committee. They will provide a detailed update on these at the next Data Committee meeting. CSS is also working on doing migrations in the Michigan Geographic Framework that is planned to be finalized by the end of February. This change will improve the Framework's interface with Roadsoft.

8.5. – Michigan Technological University/Technical Assistance Training Reports – T. Colling

8.5.1. – Monthly Training Report (August 2018) (Attachment 8)

A copy of the September 17, 2018, Training Report for the reporting period of August 1-31, 2018, was shared with the Council and briefly reviewed. MTU is preparing for the Asset Management Plan Workshops. They have prepared a training schedule for the next fiscal year that began October 1, 2018 and, have scheduled IRT and PASER trainings along with CSS that they previously shared with the Council.

8.5.2. – Monthly Activities Report (August 2018) (Attachment 9)

A copy of the September 17, 2018, Activities Report for the reporting period of August 1-31, 2018, was shared with the Council and reviewed. MTU has been very busy with the Culvert Pilot Program.

Action Item: MTU will finalize the training schedule for the rest of the fiscal year and share with the Council at the next full Council December meeting.

9. Public Comments:

None

10. Member Comments:

J. Johnson will send MDOT support staff information on conferences that she knows of to be added to the 2019 conference listing.

T. Colling thinks it might be worth doing a generic project using a standard mile of road and find out how much it costs. B. Slattery wants to take it further by finding a general cost for chip seal and other items may cost. TAMC has not done that in quite some time and this information needs to be updated. TAMC also needs to look at labor shortage and contractors as well as, update the treatment costs in Roadsoft. It

was suggested that we may want to add this to our annual report as well as show the difference in costs over the years.

11. Adjournment:

The meeting adjourned at 3:06 p.m. The next full Council meeting will be held December 5, 2018, at 1:00 p.m., MDOT Aeronautics Building, 2700 Port Lansing Road, 2nd Floor Conference Room, Lansing, Michigan.

TAMC FREQUENTLY USED ACRONYMS:	
AASHTO	AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
ACE	ADMINISTRATION, COMMUNICATION, AND EDUCATION (TAMC COMMITTEE)
ACT-51	PUBLIC ACT 51 OF 1951-DEFINITION: A CLASSIFICATION SYTEM DESIGNED TO DISTRIBUTE MICHIGAN'S ACT 51 FUNDS. A ROADWAY MUST BE CLASSIFIED ON THE ACT 51 LIST TO RECEIVE STATE MONEY.
ADA	ADULTS WITH DISABILITIES ACT
ADARS	ACT 51 DISTRIBUTION AND REPORTING SYSTEM
BTP	BUREAU OF TRANSPORTATION PLANNING (MDOT)
CPM	CAPITAL PREVENTATIVE MAINTENANCE
CRA	COUNTY ROAD ASSOCIATION (OF MICHIGAN)
CSD	CONTRACT SERVICES DIVISION (MDOT)
CSS	CENTER FOR SHARED SOLUTIONS
DI	DISTRESS INDEX
ESC	EXTENDED SERVICE LIFE
FAST	FIXING AMERICA'S SURFACE TRANSPORTATION ACT
FHWA	FEDERAL HIGHWAY ADMINISTRATION
FOD	FINANCIAL OPERATIONS DIVISION (MDOT)
FY	FISCAL YEAR
GLS REGION V	GENESEE-LAPEER-SHIAWASSEE REGION V PLANNING AND DEVELOPMENT COMMISSION
GVMC	GRAND VALLEY METRO COUNCIL
HPMS	HIGHWAY PERFORMANCE MONITORING SYSTEM
IBR	INVENTORY BASED RATING
IRI	INTERNATIONAL ROUGHNESS INDEX
IRT	INVESTMENT REPORTING TOOL
KATS	KALAMAZOO AREA TRANSPORTATION STUDY
KCRC	KENT COUNTY ROAD COMMISSION
LDC	LAPTOP DATA COLLECTORS
LTAP	LOCAL TECHNICAL ASSISTANCE PROGRAM
MAC	MICHIGAN ASSOCIATION OF COUNTIES
MAP-21	MOVING AHEAD FOR PROGRESS IN THE 21ST CENTURY (ACT)
MAR	MICHIGAN ASSOCIATION OF REGIONS
MDOT	MICHIGAN DEPARTMENT OF TRANSPORTATION
MDTMB	MICHIGAN DEPARTMENT OF TECHNOLOGY, MANAGEMENT AND BUDGET
MIC	MICHIGAN INFRASTRUCTURE COUNCIL
MITA	MICHIGAN INFRASTRUCTURE AND TRANSPORTATION ASSOCIATION
MML	MICHIGAN MUNICIPAL LEAGUE
MPO	METROPOLITAN PLANNING ORGANIZATION
MTA	MICHIGAN TOWNSHIPS ASSOCIATION
MTF	MICHIGAN TRANSPORTATION FUNDS
MTPA	MICHIGAN TRANSPORTATION PLANNING ASSOCIATION
MTU	MICHIGAN TECHNOLOGICAL UNIVERSITY
NBI	NATIONAL BRIDGE INVENTORY
NBIS	NATIONAL BRIDGE INSPECTION STANDARDS

NFA	NON-FEDERAL AID
NFC	NATIONAL FUNCTIONAL CLASSIFICATION
NHS	NATIONAL HIGHWAY SYSTEM
PASER	PAVEMENT SURFACE EVALUATION AND RATING
PNFA	PAVED NON-FEDERAL AID
PWA	PUBLIC WORKS ASSOCIATION
QA/QC	QUALITY ASSURANCE/QUALITY CONTROL
RBI	Road Based Inventory
RCKC	ROAD COMMISSION OF KALAMAZOO COUNTY
ROW	RIGHT-OF-WAY
RPA	REGIONAL PLANNING AGENCY
RPO	REGIONAL PLANNING ORGANIZATION
SEMCOG	SOUTHEAST MICHIGAN COUNCIL OF GOVERNMENTS
STC	STATE TRANSPORTATION COMMISSION
STP	STATE TRANSPORTATION PROGRAM
TAMC	TRANSPORTATION ASSET MANAGEMENT COUNCIL
TAMCSD	TRANSPORTATION ASSET MANAGEMENT COUNCIL SUPPORT DIVISION
TAMP	TRANSPORTATION ASSET MANAGEMENT PLAN
TPM	TRANSPORTATION PERFORMANCE MEASURES
UWP	UNIFIED WORK PROGRAM

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TAMC Budget Expenditure Report

11/28/18

Michigan Transportation Asset Management Council

	(most recent invoice date)	FY17 Budget $	FY17 Actual Balance	FY18 Budget $	FY18 Year to Date Spent	FY18 Year to Date Balance	FY19 Budget $	FY19 Year to Date Spent	FY19 Year to Date Balance
I. Data Collection & Regional-Metro Planning Asset Management Progam									
Battle Creek Area Transporation Study	4 qtr 18	$ 20,000.00	$ 4,555.97	$ 20,500.00	$ 20,213.36	$ 286.64	$ 20,500.00	$ -	$ 20,500.00
Bay County Area Transportation Study	4 qtr 18	$ 20,000.00	$ 9,205.58	$ 21,100.00	$ 8,028.84	$ 13,071.16	$ 21,100.00	$ -	$ 21,100.00
Central Upper Peninsula Planning and Development	3 qtr 18	$ 40,471.00	$ -	$ 47,000.00	$ 24,395.80	$ 22,604.20	$ 47,000.00	$ -	$ 47,000.00
East Michigan Council of Governments	OCT	$ 95,995.00	$ 15,902.25	$ 111,000.00	$ 81,559.65	$ 29,440.35	$ 111,000.00	$ 5,159.62	$ 105,840.38
Eastern Upper Peninsula Regional Planning & Devel.	4 qtr 18	$ 20,000.00	$ -	$ 23,100.00	$ 23,100.00	$ -	$ 23,100.00	$ -	$ 23,100.00
Genesee Lapeer Shiawasse Region V Planning Com.	JULY	$ 39,423.00	$ 2,250.94	$ 46,000.00	$ 29,609.18	$ 16,390.82	$ 46,000.00	$ -	$ 46,000.00
Grand Valley Metropolitan Council	4 qtr 18	$ 20,000.00	$ 1,025.36	$ 25,000.00	$ 12,060.69	$ 12,939.31	$ 25,000.00	$ -	$ 25,000.00
Kalamazoo Area Transportation Study	AUGUST	$ 20,000.00	$ 871.89	$ 22,000.00	$ 15,451.33	$ 6,548.67	$ 22,000.00	$ -	$ 22,000.00
Macatawa Area Coordinating Council	4 qtr 18	$ 20,000.00	$ 12,594.34	$ 20,200.00	$ 9,575.57	$ 10,624.43	$ 20,200.00	$ -	$ 20,200.00
Midland Area Transportation Study	3 qtr 18	$ 20,000.00	$ 2,339.46	$ 21,000.00	$ 3,981.92	$ 17,018.08	$ 21,000.00	$ -	$ 21,000.00
Northeast Michigan Council of Governments	AUGUST	$ 43,426.45	$ -	$ 52,200.00	$ 46,000.00	$ 6,200.00	$ 46,000.00	$ -	$ 46,000.00
Networks Northwest	SEPT	$ 61,316.00	$ -	$ 72,000.00	$ 71,915.46	$ 84.54	$ 72,000.00	$ -	$ 72,000.00
Region 2 Planning Commission	3 qtr 18	$ 37,940.00	$ 13,196.44	$ 42,000.00	$ 18,368.33	$ 23,631.67	$ 42,000.00	$ -	$ 42,000.00
Saginaw County Metropolitan Plannning Commission	3 qtr 18	$ 20,000.00	$ 8,414.71	$ 22,200.00	$ 17,495.94	$ 4,704.06	$ 22,200.00	$ -	$ 22,200.00
Southcentral Michigan Planning Commission	JULY	$ 53,162.00	$ 16,246.33	$ 57,300.00	$ 26,240.09	$ 31,059.91	$ 57,300.00	$ -	$ 57,300.00
Southeast Michigan Council of Governments	OCT	$ 135,680.00	$ 0.40	$ 174,000.00	$ 174,000.00	$ -	$ 174,000.00	$ 9,816.07	$ 164,183.93
Southwest Michigan Planning Commission	4 qtr 18	$ 37,030.00	$ -	$ 41,000.00	$ 41,000.00	$ -	$ 41,000.00	$ -	$ 41,000.00
Tri-County Regional Planning Commission	4 qtr 18	$ 33,786.00	$ -	$ 40,000.00	$ 21,680.54	$ 18,319.46	$ 40,000.00	$ -	$ 40,000.00
West Michigan Regional Planning Commission	SEPT	$ 82,467.00	$ -	$ 91,000.00	$ 55,428.20	$ 35,571.80	$ 91,000.00	$ -	$ 91,000.00
West Michigan Shoreline Regional Development Com.	SEPT	$ 46,781.56	$ 636.55	$ 54,000.00	$ 51,333.45	$ 2,666.55	$ 54,000.00	$ -	$ 54,000.00
Western Upper Peninsula Regional Planning & Devel.	4 qtr 18	$ 34,867.00	$ 19.47	$ 40,000.00	$ 40,000.00	$ -	$ 40,000.00	$ -	$ 40,000.00
MDOT Region Participation & PASER Quality Control	10/14/18	$ 62,750.00	$ (22,587.50)	$ 80,000.00	$ 52,914.97	$ 27,085.03	$ 91,440.00	$ -	$ 91,440.00
Fed. Aid Data Collection & RPO/MPO Program Total		**$ 965,095.01**	**$ 64,672.19**	**$ 1,116,400.00**	**$ 844,353.32**	**$ 272,046.68**	**$ 1,116,400.00**	**$ 14,975.69**	**$ 1,101,424.31**
PASER PNFA Data Collection Total		**$ 40,760.39**	**$ -**	***(FY18 PNFA Moved Into Data Collection Program Above)***			***(FY19 PNFA Moved Into Data Collection Program Above)***		
III. TAMC Central Data Agency (MCSS)									
Project Mgmt	9/14/18	$ 37,800.00	($2,264.00)	$ 42,000.00	$ 46,585.00	$ (4,585.00)	$ 42,000.00	$ -	$ 42,000.00
Data Support /Hardware/Software	9/14/18	$ 60,200.00	$1,367.00	$ 68,800.00	$ 67,800.00	$ 1,000.00	$ 68,000.00	$ -	$ 68,000.00
Application Development / Maintenance / Testing	9/14/18	$ 83,280.00	$5,042.00	$ 114,475.00	$ 115,250.00	$ (775.00)	$ 114,000.00	$ -	$ 114,000.00
Help Desk / Misc Support	9/14/18	$ 66,600.00	$948.00	$ 70,200.00	$ 68,200.00	$ 2,000.00	$ 70,000.00	$ -	$ 70,000.00
Training	9/14/18	$ 27,600.00	($1,533.00)	$ 34,950.00	$ 24,850.00	$ 10,100.00	$ 34,960.00	$ -	$ 34,960.00
Data Access / Reporting	9/14/18	$ 47,155.00	$1,459.00	$ 49,575.00	$ 52,175.00	$ (2,600.00)	$ 49,600.00	$ -	$ 49,600.00
FY17 Off Budget: IRT Re-write - $241,000	9/30/17	*$ 241,040.00*	*$ (18,983.00)*						
TAMC Central Data Agency (MCSS) Total		**$ 322,635.00**	**$ 5,019.00**	**$ 380,000.00**	**$ 374,860.00**	**$ 5,140.00**	**$ 378,560.00**	**$ -**	**$ 378,560.00**
IV. TAMC Training & Education (MTU) Calendar Year Z1	11/125/18	**$ 210,000.00**	**$ 1,341.10**	**$ 235,000.00**	**$ 140,622.07**	**$ 94,377.93**	**$ 220,000.00**	**$ -**	**$ 220,000.00**
V. TAMC Activities (MTU) Z15/R1	9/18/18	**$ 70,000.00**	**$ 9,746.50**	**$ 115,000.00**	**$ 114,089.32**	**$ 910.68**	**$ 120,000.00**	**$ -**	**$ 120,000.00**
VI. TAMC Expenses									
Fall Conference Expenses	12/8/17	$ 6,000.00		$ 10,000.00	$ 7,269.00		$ 10,000.00	$ -	
Fall Conf. Attendence Fees + sponsorship Fees	12/8/17	$ -		$ -	$ 4,405.00		$ -	$ -	
Net Fall Conference	12/8/17	$ 8,625.00	$ 312.60	$ 14,405.00	$ 7,269.00	$ 7,136.00	$ 10,000.00	$ -	$ 10,000.00
Spring Conference Expenses	11/5/18	$ 8,000.00	$ -	$ 3,800.00	$ 7,439.36		$ 10,000.00	$ -	
Spring Conf. Attendence Fees + sponsorship Fees	8/17/18	$ -	$ -	$ -	$ 8,350.00		$ -	$ -	
Net Spring Conference	11/5/18	$ 14,140.00	$ 7,418.20	$ 12,150.00	$ 7,439.36	$ 4,710.64	$ 10,000.00	$ -	$ 10,000.00
Other Council Expenses	9/28/18	$ 3,915.29	$ (4,567.95)	$ 10,000.00	$ 7,301.72	$ 2,698.28	$ 10,000.00	$ -	$ 10,000.00
TAMC Expenses Total		**$ 26,680.29**	**$ 3,162.85**	**$ 36,555.00**	**$ 22,010.08**	**$ 14,544.92**	**$ 30,000.00**	**$ -**	**$ 30,000.00**
VII. Culvert Pilot Project									
Central Data Agency (MCSS)	10/16/18	$ -	$ -	$ 15,000.00	$ 9,312.00	$ 5,688.00	$ -	$ -	$ -
MTU Project Management	11/7/18			$ 172,100.00	$ 150,000.00	$ 22,100.00	$ -	$ -	$ -
TAMC Administration & Contingency	11/7/18	$ -	$ -	$ 84,438.00	$ -	$ 84,438.00	$ -	$ -	$ -
Central Upper Peninsula Planning and Development	3 qtr 18	$ -	$ -	$ 88,641.00	$ 25,726.56	$ 62,914.44	$ -	$ -	$ -
East Michigan Council of Governments	SEPT	$ -	$ -	$ 328,607.00	$ 259,229.13	$ 69,377.87	$ -	$ -	$ -
Eastern Upper Peninsula Regional Planning & Devel.	4 qtr 18	$ -	$ -	$ 5,688.00	$ 5,034.70	$ 653.30	$ -	$ -	$ -
Genesee Lapeer Shiawasse Region V Planning Com.	JULY	$ -	$ -	$ 124,909.00		$ 124,909.00	$ -	$ -	$ -
Grand Valley Metropolitan Council	4 qtr 18	$ -	$ -	$ 77,782.00	$ 69,733.25	$ 8,048.75	$ -	$ -	$ -
Kalamazoo Area Transportation Study	AUGUST	$ -	$ -	$ 50,402.00	$ 14,970.42	$ 35,431.58	$ -	$ -	$ -
Northeast Michigan Council of Governments	AUGUST	$ -	$ -	$ 33,506.00	$ 21,781.96	$ 11,724.04	$ -	$ -	$ -
Networks Northwest	SEPT	$ -	$ -	$ 184,513.00	$ 163,641.05	$ 20,871.95	$ -	$ -	$ -
Region 2 Planning Commission	3 qtr 18	$ -	$ -	$ 54,900.00	$ 2,328.00	$ 52,572.00	$ -	$ -	$ -
Southcentral Michigan Planning Commission	JULY	$ -	$ -	$ 93,456.00	$ 894.62	$ 92,561.38	$ -	$ -	$ -
Southeast Michigan Council of Governments	SEPT	$ -	$ -	$ 87,644.00	$ 45,757.96	$ 41,886.04	$ -	$ -	$ -
Southwest Michigan Planning Commission	4 qtr 18	$ -	$ -	$ 101,849.00	$ 67,138.17	$ 34,710.83	$ -	$ -	$ -
Tri-County Regional Planning Commission	4 qtr 18	$ -	$ -	$ 47,587.00	$ 6,962.44	$ 40,624.56	$ -	$ -	$ -
West Michigan Regional Planning Commission	SEPT	$ -	$ -	$ 241,511.00	$ 181,441.39	$ 60,069.61	$ -	$ -	$ -
West Michigan Shoreline Regional Development Com.	SEPT	$ -	$ -	$ 144,238.00	$ 89,092.30	$ 55,145.70	$ -	$ -	$ -
Western Upper Peninsula Regional Planning & Devel.	4 qtr 18	$ -	$ -	$ 63,229.00	$ 46,960.41	$ 16,268.59	$ -	$ -	$ -
Culvert Pilot Project Total		$	$	**$ 2,000,000.00**	**$ 1,160,004.36**	**$ 839,995.64**	$ -	$ -	$ -
Total Program		**$ 1,635,170.69**	**$ 83,941.64**	**$ 3,882,955.00**	**$ 2,655,939.15**	**$ 1,227,015.85**	**$ 1,864,960.00**	**$ 14,975.69**	**$ 1,849,984.31**
Appropriation		**$ 1,626,400.00**		**$ 3,876,400.00**		**31.60%**	**$ 1,876,400.00**		**99.20%**

2018 Michigan Local Agency Pavement Treatment Life Study

Michigan Transportation Asset Management Council

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Civil and Environmental Engineering

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October 25, 2018

ACKNOWLEDGEMENTS

We would like to thank the thirty-six Michigan local agencies that volunteered their data for analysis in this report. Without their generosity and hard work of collecting, entering, and maintaining the data, this analysis would not be possible. We would also like to thank Victoria Sage, technical writer at the Center for Technology & Training, for her assistance with producing this report.

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EXECUTIVE SUMMARY

The Michigan Transportation Asset Management Council (TAMC) tasked the Center for Technology & Training (CTT) to determine updated statewide extended service life averages for pavement repair treatments used by Michigan's local agencies. The CTT, on behalf of the TAMC, previously conducted this study in 2014 and issued the report *Local Agency Capital Preventative Maintenance Extended Treatment Life Study* (Colling, Kiefer, & Farey, 2014). The 2014 study relied on the Extended Service Life (ESL) Calculator in the Roadsoft program, which is available to all Michigan local agencies at no cost to them. The current study used an updated version of the ESL Calculator. Thirty-six Michigan local agencies volunteered their data to the CTT for analysis, and twenty-nine of those agencies had data that met the criteria set forth in this study. This qualifying data set contained 6,236 road segments and 1,709.774 miles (2,751.615 kilometers) of roadway.

Large enough sample sizes were present to make statewide conclusions on five pavement treatments: chip seal, chip seal plus fog, thin overlay, crush and shape, and thick overlay (see Table 1 below). Michigan local agencies obtain a three-year increase in ESL when applying a fog seal in conjunction with a chip seal. Also notable is the 0.3-year decrease in ESL when applying a chip seal treatment to a pavement that has previously received a chip seal treatment.

Table 1: Summary of Weighted Average ESLs for Five Treatment Types

Treatment	Weighted Avg ESL
Heavy CPM	
Chip seal	**4.1**
Chip seal plus fog seal	**7.1**
Thin overlay	**6.9**
Rehabilitation	
Crush and shape	**11.3**
Thick overlay	**9.1**

The project team attempted to further analyze the data set by legal system, National Function Class, number of lanes, and region of the state. However, breaking the data into smaller subdivisions offered less opportunity to make any significant determinations. The factors that impact the effectiveness of repair treatments are highly variable when comparing multiple projects in aggregate, and trying to determine why segments of the data differed from others is difficult with the variability in pavements and practice. The statewide average ESL gain provides the best guidance for ESL gain because it includes samples that span a number of variables (e.g., agency policies, soil type, annual snowfall, underlying pavement structure, materials used, and construction methods) that are beyond the control of this study. The large data set available for analysis in Michigan demonstrates that the many types of treatments used by Michigan local agencies provide significant increases in extended service life.

1 INTRODUCTION

This study focuses on determining the extended service life (ESL) that can be gained for asphalt pavements by selecting and applying various preventive maintenance and repair treatments from data provided by Michigan local agencies. The Michigan Transportation Asset Management Council (TAMC) commissioned this study to collect ESL data for their own use as well as to show local agencies that they also have the tools and data necessary to complete their own ESL analyses as part of their annual business processes. The Center for Technology & Training (CTT), on behalf of the TAMC, conducted a similar study in 2014; in their final report *Local Agency Capital Preventative Maintenance Extended Treatment Life Study*, the CTT was only able to make definitive conclusions on chip seal treatments due to the limited data set (Colling, Kiefer, & Farrey, 2014). TAMC suggested repeating this study in 2018 due to the expected larger data set.

Analysis of data for the 2018 study exclusively uses distresses found in asphalt pavement since asphalt is the primary pavement type owned by Michigan local agencies. The study determined that local agencies in Michigan are actively using many types of repair treatments to maintain their asphalt pavements. However, chip seals are still the most widely used preventive maintenance treatment.

Modeling the extended service life resulting from repair treatments can effectively illustrate the value gained by applying repair treatments (Colling, Kiefer, & Farrey; 2014). Figure 1 shows a pavement that has been maintained in fair condition for nearly 22 years with three successive chip seal applications.

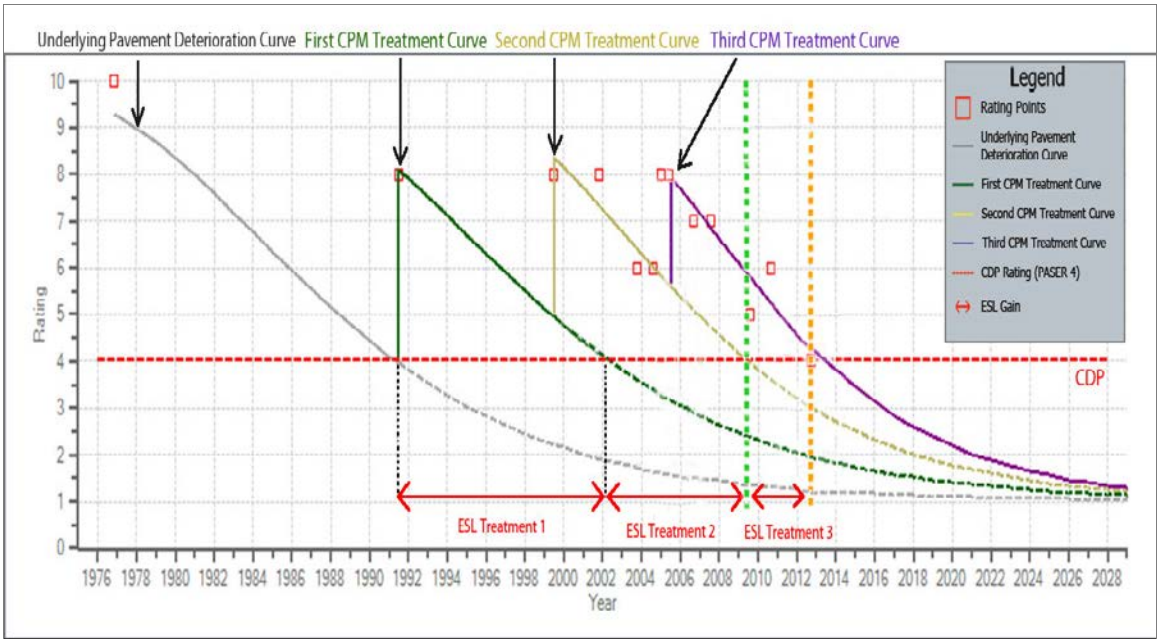

Figure 1: Example of multiple chip seal treatments. Note the diminishing ESL with successive treatment applications.

2 BACKGROUND

As a condition of Public Act 199 of 2007, Michigan road-owning agencies must collect road condition data annually on their Federal-aid-eligible road network. Additional condition data can also be collected on the non-Federal-aid-eligible portions of their road network at the discretion of the individual road-owning agency. Agencies rate road conditions using the Pavement Surface Evaluation and Rating (PASER) system, which is based on the severity, type, and extent of distresses present in the pavement. Since 2008, agencies have been collecting and submitting 100 percent of their Federal-aid-eligible road-network condition data on a two-year cycle with a minimum goal of 50-percent collection each year; between 2004 and 2007, agencies were collecting 100 percent of the network condition data each year. For the purpose of this study, agencies were not required to collect any data in addition to what was already collected for annual reporting.

Over 400 Michigan road-owning agencies currently use Roadsoft, a roadway asset management software program developed in the early 1990s at Michigan Technological University in cooperation with the Michigan Department of Transportation (MDOT) (see Roadsoft.org for more information). This software—made available to Michigan local agencies at no charge—provides tools for the data collection, storage, and analyses necessary to effectively apply asset management principles. The agencies that have been using Roadsoft typically store road condition and treatment data in Roadsoft that, in turn, could be used for ESL analyses.

In 2013, the TAMC funded the development of a Roadsoft tool—the Extended Service Life (ESL) Calculator—that enables local agencies to perform ESL analyses for their historical repair treatments. Roadsoft also has performance modeling functionality: it can generate a deterioration curve for the underlying pavement and for the same pavement subsequent to repair treatments (Figure 2). These modeling functions use a road segment's condition data (i.e., its PASER score) and treatment data (i.e., its maintenance history).

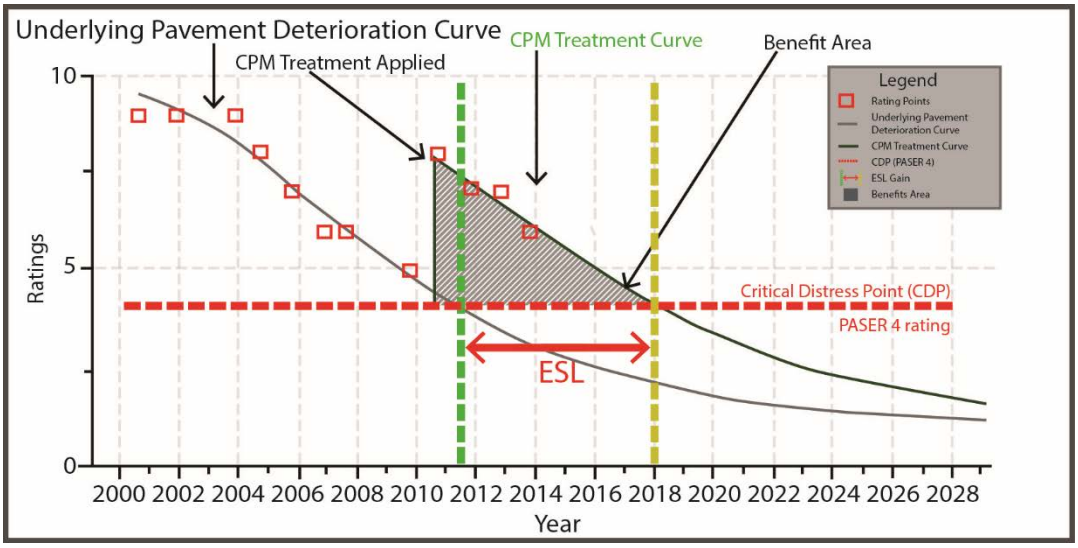

Figure 2: Example deterioration curve for the underlying pavement and subsequent repair treatment

2.1 Definition of Pavement Deterioration Technical Terms

The following terms refer to elements of the pavement deterioration curves [1]:

Underlying pavement deterioration curve: deterioration for the asphalt pavement prior to repair treatment

Repair treatment curve: deterioration for the asphalt pavement following the application of a repair treatment

Treatment applied: the time when the repair treatment was applied over the asphalt surface

Rating points: actual pavement condition ratings (using PASER) documented during TAMC data collection

Critical distress point (CDP): the PASER 4 line—when pavement deterioration changes from exhibiting age-related to structural distresses

ESL gain: the time in years gained by the application of a treatment

Benefits area: the area above the CDP that lies between the underlying pavement deterioration curve and the repair treatment curve.

2.2 Cost-effective Management of Assets

Asset management is the ongoing process of maintaining, upgrading, and operating physical assets in a cost-effective manner; it relies on continuous physical inventory and condition assessment.[2] Asset management principles give guidance for the cost-effective management of

[1] For more information on the technical process that Roadsoft uses for pavement modeling, refer to Dong, McNinch, and Colling's "*Validation of the Use of PASER Condition Data and the Application of Growth Models for Predicting Local Agency Pavement Deterioration*" in Conference Proceedings Transportation Research Board, 8th National Conference on Asset Management, October 18, 2009.

[2] From Act 499, Public Acts of 2002, Michigan Department of Transportation. Available at: *www.mcgi.state.mi.us/mitrp/document.aspx?id=348*

pavements. In other words, the premise of asset management is to “keep good roads maintained in good condition.” The primary way of doing this is by applying relatively-low-cost repair treatments to extend pavement life, thereby delaying the need for costly rehabilitation and reconstruction.

Cost-effectiveness is a prime factor that road agencies use when selecting treatments because they generally need to maximize the use of limited agency funds. Determining the cost-effectiveness of repair treatments requires an agency to be cognizant of two factors: the treatment’s cost per-lane-mile and the amount of ESL that the treatment provides. Local agencies are usually very aware of the cost of repair treatments; however, the value of repair treatments in terms of ESL is seldom known beyond theoretical studies.

An accurate analysis of the ESL afforded by each repair treatment based on local data allows agencies to do two things: set a data-driven policy for applying specific treatments and provide a quantitative means for assessing the viability of treatment locations.

2.3 Asphalt Pavement Deterioration

Age-related distresses result from exposure to the environment over time. The primary environmental factors driving age-related distresses are water (which enters the pavement structure and weakens it), ultra-violet light, and atmosphere (which causes degradation of the asphalt binder and subsequent hardening). Asphalt binder is the “glue” that holds together the aggregates in an asphalt pavement. As the asphalt binder hardens, it becomes less flexible and is subject to cracking from tensile forces that develop during low-temperature events when the pavement contracts. Cracking allows the intrusion of water into the underlying pavement structural layers. Excess water makes the aggregate base and sub-base layers less rigid, which results in a larger magnitude displacement of the pavement layers at a given load. Distressed asphalt is then subject to increased vertical displacement of the pavement due to traffic loads, causing increased cracking and structural damage to the asphalt layer. Examples of age-related distresses include transverse cracking, longitudinal joint cracking, and block cracking (Figure 3). These cracks are “non-working” cracks: the pavement on each side has the ability to transfer load from one side of the crack to the other so the pavement on each side moves in unison as a load passes over.

Figure 3: Age-related distresses

Structural distresses can occur at any time in the life of a pavement. These distresses typically result from traffic loading. Traffic loads in excess of the pavement's design load can speed the occurrence of structural distress. Examples of structural distresses include rutting, cracking in the wheel path, and alligator (fatigue) cracking (Figure 4). Structural-distress-related cracks are "working" cracks: the pavement on each side of a working crack moves independently as a load passes over. Capital preventive maintenance treatments are not structural in nature and, therefore, have a limited ability to span and maintain continuity across a working crack.

Figure 4: Structural distresses

2.4 Capital Preventive Maintenance

Capital preventive maintenance (CPM) treatments typically address age-related pavement distresses prior to the presence of structural distresses. These treatments retard or offset age-related distresses. The TAMC classifies CPM treatments as either light or heavy. Common light CPM treatments include crack seal and fog seal, whereas common heavy CPM treatments include chip seal, slurry seal, cape seal, microsurface, and thin asphalt overlays. Other more specialized or proprietary CPM treatments exist.

2.4.1 Crack Seal (Light)

***Description*:** A crack seal is a localized treatment method for cracks less than 0.75 inches (1.91 centimeters) wide. It is a sealant that fills a crack, which has been cleaned of debris by using a saw or router to create a clean reservoir. Crack seal is effective for approximately two years and has a lower per lane mile cost, making it a cost-effective solution in terms of per-year cost of extending service life.

***Purpose*:** Crack seal prevents water and/or incompressible material from entering the pavement structure. Intrusion of water and/or incompressible material can weaken a pavement's base and inhibit the pavement from expanding and contracting freely.[3] Traffic loads can cause more damage to these weakened pavements

2.4.2 Cape Seal (heavy)

***Description*:** A cape seal is a chip seal followed by a microsurface cover.

[3] From *Best Practices Handbook on Asphalt Pavement Maintenance,* Minnesota Technology Transfer Center/LTAP, 2000. Available at: http://www.mnltap.umn.edu/publications/handbooks/documents/asphalt.pdf

***Purpose*:** Cape seal treatments maximize the positive aspects of both chip seal and microsurface treatments by applying them together. The microsurface provides a dimensionally-stable layer that bridges defects, such as minor rutting, and provides a smoother travelling surface.[4] The chip seal provides a flexible membrane that disperses stress from cracks or defects in the underlying pavement; this protects the microsurface from early reflective cracking and provides additional waterproofing in the event of a crack in the microsurface.

2.4.3 Chip Seal or Seal Coat (Heavy)

***Description*:** A chip seal—also known as seal coat—is an emulsion bond coat followed by an aggregate cover. A double chip seal is two consecutive layers of chip seal (asphalt bond coat and aggregate cover). Chip seal cures using a thermal-break process, which takes two to eight hours depending on climate conditions. Rapid-setting asphalt emulsions are available and commonly used. Chip seal lasts approximately five years. In some applications, chip seal can be combined with fog seal (see Fog Seal, below).

***Purpose*:** Chip seal treatment protects pavement from environmental deterioration. A chip seal creates a waterproof membrane that prevents hardening and/or oxidation of the pavement and prevents water intrusion into the pavement structure, thereby helping an asphalt pavement to retain its flexibility and resistance to cracking.[5] Chip seal can also provide low-severity crack sealing and restore surface friction.

2.4.4 FOG Seal (Light)

***Description*:** Fog seal is a diluted asphalt emulsion without a cover aggregate. Fog seal is applied to a pavement using an asphalt distributor. Fog seal lasts approximately two years. While fog seal itself is considered a light CPM treatment, it can be combined with chip seal for a heavy CPM treatment. Many Michigan local agencies apply fog seal directly over new chip seal as a standard practice on heavily traveled roads since the fog seal treatment provides waterproofing for the chip seal's stone chips and guarantees sufficient asphalt cement to retain the stone chips.

***Purpose*:** Fog seal treatment seals and enriches the asphalt pavement surface, seals minor cracks, prevents raveling, and provides shoulder delineation.[6] While fog seal has been used on both low- and high-volume roads to prevent raveling and create delineation between travel lanes and shoulders, its use on high-volume roads is restricted due its reduction of pavement friction.

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[4] From Central Federal Lands Highway website, http://www.cflhd.gov/programs/techDevelopment/pavement/context-roadway-surfacing/documents/context5-append-a1.pdf

[5] From: *Best Practices Handbook on Asphalt Pavement Maintenance,* Minnesota Technology Transfer Center/LTAP, 2000. Available at: http://www.mnltap.umn.edu/publications/handbooks/documents/asphalt.pdf

[6] From *Best Practices Handbook on Asphalt Pavement Maintenance,* Minnesota Technology Transfer Center/LTAP, 2000. Available at: http://www.mnltap.umn.edu/publications/handbooks/documents/asphalt.pdf

2.4.5 Microsurface (Heavy)

***Description*:** Microsurface uses a modified liquid asphalt, small stones, water, and portland cement—much like slurry seal—that are cured in a chemically-controlled process. Consequently, it is sometimes incorrectly referred to as a polymer-modified slurry seal. Microsurface lasts approximately seven years.

***Purpose*:** Microsurface restores the transverse cross-section of a pavement profile.[7] It is used for rut filling, surfacing for roads with moderate- to heavy-volume traffic, increasing skid resistance, and reducing water intrusion into the pavement structure. Generally, microsurface is applied as a surfacing at less than 0.5 inches (1.27 centimeters), which adds no strength to the pavement structure but simply seals it from environmental deterioration agents.

2.4.6 Slurry Seal (Heavy)

***Description*:** Slurry seal is a mixture of fine aggregate, asphalt emulsion, water, and mineral filler (often portland cement) that uses a thermal-break process for curing. Thermal-break curing requires heat from the sun and pavement, and can take two to eight hours depending on the heat and humidity. Slurry seal lasts approximately four years.

***Purpose*:** Slurry seal treatment seals the asphalt surface, slows surface raveling, seals minor cracks, and improves surface friction. Slurry seal effectively remedies pavements prone to excessive oxidation and hardening of the existing surface. However, it is minimally effective if the underlying pavement contains extensive cracks.[8]

2.4.7 Thin Overlay (Heavy)

***Description*:** Thin hot-mix-asphalt (HMA) overlays are blends of aggregate (different gradations possible) and asphalt cement often modified with polymer. Three gradation types of thin overlay are dense-graded, open-graded friction courses, and gap-graded. Typically, thin overlay range in thickness from 0.75 to 1.5 inches (1.91 to 3.81 centimeters).

***Purpose*:** Thin overlays provide functional (non-structural) improvement as well as enhance smoothness, friction, and/or profile of asphalt pavements. However, they add little or no additional load-carrying capacity. Thin overlays are effective in all climatic conditions and on all types of roadways; they are particularly suitable for high-volume roads in urban areas where longer life and relatively low-noise surfaces are desired.[9]

2.5 Rehabilitation

Road requiring rehabilitation typically exhibit structural distresses like alligator cracking and rutting. Rutting is evidence of underlying structural failure and must be treated with a

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[7] From *Best Practices Handbook on Asphalt Pavement Maintenance,* Minnesota Technology Transfer Center/LTAP, 2000. Available at: http://www.mnltap.umn.edu/publications/handbooks/documents/asphalt.pdf

[8] From *Best Practices Handbook on Asphalt Pavement Maintenance,* Minnesota Technology Transfer Center/LTAP, 2000. Available at: http://www.mnltap.umn.edu/publications/handbooks/documents/asphalt.pdf

[9] From *Best Practices Handbook on Asphalt Pavement Maintenance,* Minnesota Technology Transfer Center/LTAP, 2000. Available at: http://www.mnltap.umn.edu/publications/handbooks/documents/asphalt.pdf

rehabilitation option like crush and shape. In some cases, structural failure may call for reconstruction instead of rehabilitation.

2.5.1 Cold in-Place

***Description*:** Cold in-place (CIP)—also known as CIP recycling—is a rehabilitation technique that requires pulverizing the existing asphalt, milling it, mixing it with new binder and materials, laying the new mixture as a base layer, and applying an overlay or surface treatment. It works well on moderate- to high-volume roadways. CIP maximizes use of existing materials and is a quick rehabilitation process.[10]

***Purpose*:** CIP treats surface distresses that can reach up to 4 inches (10.2 centimeters) into the pavement structure.[11]

2.5.2 Crush and Shape

***Description*:** Crush and shape is pulverization of a pavement and its base, followed by adding new gavel (optional), re-profiling the pavement, and placing a new wearing surface (such as an HMA overlay or chip seal). When crush and shape is used on urban roads, curb-and-gutter work is necessary. Crush and shape generally lasts 14 years.

***Purpose*:** This treatment corrects severe structural distresses on rural roads. Additional gravel and an HMA overlay boost the pavement's structural capacity.

2.5.3 Hot in-place

***Description*:** Hot in-place (HIP)—also known as HIP recycling—is a rehabilitation technique that incorporates surface recycling, remixing, and repaving. The existing asphalt is softened and then mixed with new asphalt; this softened and mixed asphalt is then laid over the remaining pavement structure and overlaid with HMA. HIP is a quick rehabilitation process but is sensitive to cooler temperatures and precipitation.[12]

***Purpose*:** HIP treats distresses in a pavement's surface layer (typically those distresses in the top 2 inches, or 5.1 centimeters). It also corrects functional distresses like surface cracking, raveling, and friction loss.[13]

2.5.4 Hot-mix-asphalt Wedge

***Description*:** Hot-mix-asphalt (HMA) wedge is a narrow 2- to 6-foot-wide (0.6- to 1.8-meter wide) wedge placed along the entire outside edge of a lane; the entire lane—including the section with the wedge—often receives an HMA or chip seal overlay to provide a new riding surface. This repair is often used as a stop-gap treatment in replace of a more expensive

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[10] From *Identifying Best Practices in Pavement Design, Materials, Construction, and Maintenance in Wet-Freeze Climates Similar to Michigan*, You, Z., Gilbertson, C., Van Dam, T., 2017: Michigan Department of Transportation.

[11] From *Identifying Best Practices in Pavement Design, Materials, Construction, and Maintenance in Wet-Freeze Climates Similar to Michigan*, You, Z., Gilbertson, C., Van Dam, T., 2017: Michigan Department of Transportation

[12] From *Identifying Best Practices in Pavement Design, Materials, Construction, and Maintenance in Wet-Freeze Climates Similar to Michigan*, You, Z., Gilbertson, C., Van Dam, T., 2017: Michigan Department of Transportation

[13] From *Identifying Best Practices in Pavement Design, Materials, Construction, and Maintenance in Wet-Freeze Climates Similar to Michigan*, You, Z., Gilbertson, C., Van Dam, T., 2017: Michigan Department of Transportation

repair that may not be fiscally possible. HMA wedge lasts approximately four years or longer for overlaid wedges.

***Purpose*:** HMA wedge corrects edge damage. It adds strength to severely settled areas of the pavement.

2.5.5 Thick Overlay

***Description*:** Thick overlay is a layer of new asphalt (liquid and stones) placed on an existing pavement. The overlay is over 1.5 inches (3.81 centimeters). Thick overlay lasts approximately five to ten years. It can be combined with mill treatment, which is the removal of the pavement surface via milling.

***Purpose*:** This treatment creates a new wearing surface for traffic and seals the pavement from water, debris, and sunlight. Depending on the overlay thickness, this treatment can add significant structural strength. A mill and overlay removes severe damage, preventing reflected structural problems, and omits the need for curb-and-gutter work.

2.6 Reconstruction

***Description*:** Pavement reconstruction involves complete removal of the old pavement and base followed by the construction of an entirely new road. Reconstruction lasts approximately 15 years. Comparatively, it is the most expensive treatment option and most disruptive to daily traffic. During its service life, a reconstructed pavement will likely require one or more CPM or rehabilitation treatments.

***Purpose*:** Reconstruction is appropriate when more cost-effective treatment options have been exhausted or when a road requires significant changes to its geometry, base, or underlying utilities.

3 GOAL OF THIS STUDY

ESL can be gained by applying the appropriate repair treatment on a pavement deteriorating from distress. The goal of this study is to determine the average ESL gain broken down by the category of treatment for the various treatments used by Michigan local agencies from the data set provided. The data will also be analyzed for any other similarities that can be associated with variations in the data set.

4 METHODS

This study employed an updated version of the ESL Calculator to select candidate roadway segments and evaluate whether they met the study selection criteria; the study also relied on Roadsoft's performance modeling functionality, including the deterioration curves that it can generate (see Figure 1).

Measuring the ESL created by a given treatment can help determine the benefit of repair treatments. ESL is the additional time in years that the pavement is above the CDP—or the additional time in years before the pavement experiences structural distresses (PASER 4 or below)—due to the repair treatment (Figure 5). This method evaluates the additional time before a pavement needs expensive treatments like rehabilitation or reconstruction. The ESL benefit directly affects the cost of roadway maintenance since it creates a tangible extension in pavement life.

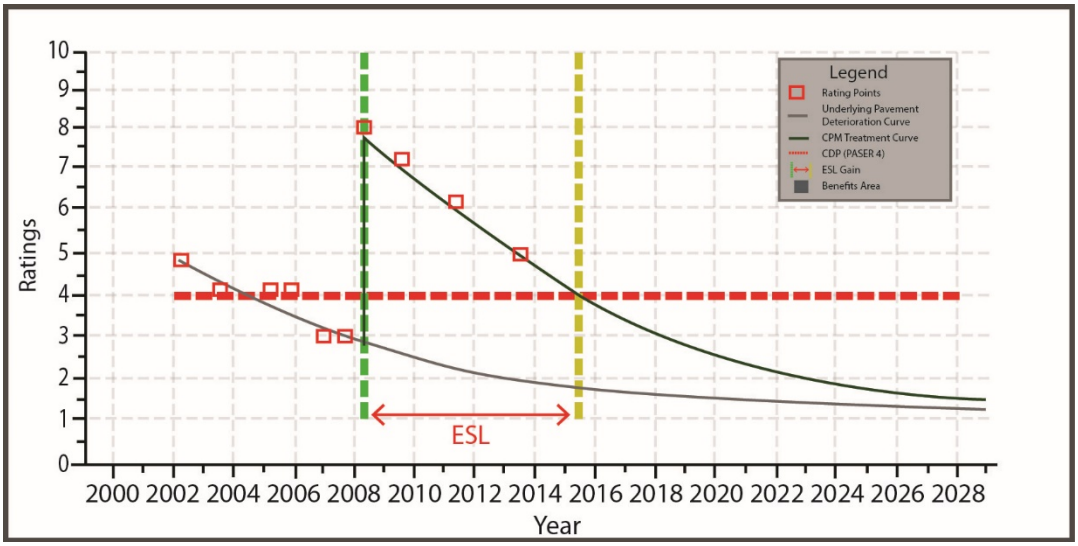

Figure 5: Example segment showing ESL with a positive improvement (gain) resulting from repair treatment and a decrease in pavement condition over time. In this instance, the underlying pavement deterioration curve crosses the CDP (PASER 4 line) prior to the pavement receiving a repair treatment.

4.1 Development of Data Set

The Center for Technology & Training (CTT) requested that Michigan local agencies submit their pavement condition and treatment data for this study. Because participation was voluntary, marketing was necessary to generate interest. Approximately 1,100 Michigan local agencies in the CTT database were contacted to request agency participation in the study. Advertisements for participation in the study were also circulated at conferences and training where local agency participation was expected.

The study did not require local agencies to perform excessive or in-depth data collection in order to illustrate how ESL analyses can be integrated into a local agency business process.

Local agencies only needed to provide basic data that they were already collecting as part of the annual TAMC collection effort. Local agencies exported data sets from Roadsoft—which most Michigan road-owning agencies already use to collect, analyze, and store their pavement management data—and sent them to the CTT via e-mail or FTP site uploads. Received data sets were verified for completeness, and catalogued by date and by submitting agency.

4.2 Selection Criteria of Qualifying Data for Analysis

Stringent criteria for selecting repair treatments minimizes modeling effects that would potentially bias results of this study. Restrictive selection criteria ensure that the study results are reliable and reflects the actual benefit provided by the repair treatment. Two sets of selection criteria were used to generate the final data set: road network selection criteria and repair treatment selection criteria.

Each agency's data set was evaluated in Roadsoft using the network builder and filter tools to isolate the portions of the road network meeting selection criteria. Road network selection criteria used in this study were as follows:

- Pavement segments must be asphalt designated with an asphalt standard surface sub-type or designated as a similarly-constructed asphalt pavement with a surface sub-type name defined by the local agency. Asphalt pavements comprise the majority of paved roadway miles owned by local agencies in Michigan. Since the expected life of an asphalt pavement without preventive maintenance treatments is approximately 15 years, asphalt segments in Michigan will fall into various PASER categories. Limiting asphalt pavements to standard surface sub-types provides uniformity in the construction of the asphalt pavement whereas other asphalt pavements may be built to varying standards that affect both their service life and extended service life consequent to repair treatments.
- Segments must be Federal-aid-eligible. Because the Federal-aid network is eligible for Federal funding, it likely receives the majority of repair treatment activity, thus providing the greatest number of candidate segments for the study.

Qualifying road segments were assessed for repair treatments meeting selection criteria. An updated version of Roadsoft's ESL Calculator was used to identify and evaluate repair treatments on the qualifying network that met repair treatment selection criteria. The updated ESL Calculator, which will be released to Roadsoft users in the near future, was used to produce modified ESL calculations to simplify data analysis for this study. The repair treatment selection criteria used in this study were as follows:

- The repair treatments must be the first treatment in its TAMC treatment classification system (i.e., light CPM, heavy CPM, rehabilitation, or reconstruction) applied over the original asphalt pavement or over a heavier or lighter treatment than the one being

analyzed; treatments applied over similar treatment classes were separated into a data set that analyzed diminishing returns. When a treatment of the same classification is applied multiple times over a surface without increasing the pavement's structure with an HMA overlay (e.g., a chip seal applied over a chip seal), the subsequent treatment yields diminishing returns, or reduced effectiveness at extending the pavement's life or realizing ESL consequent to treatment.

- Qualifying road segments must have a minimum of three PASER scores prior to and three following the treatment of interest. This can reasonably define the underlying pavement deterioration curve (determined from three scores or more prior to treatment) as well as the repair treatment curve (determined from three scores or more following the treatment).
- The treatment could not be a crack seal or a crack fill. The PASER system is not sensitive enough to show rating changes due to applying a crack seal treatment, which makes measuring benefit of this short-life treatment difficult. Nonetheless, crack seal is low cost, and research suggests it provides an additional ESL of one to three years when applied correctly.
- The data must be from the year 2000 or subsequent years. Data collected prior to the year 2000 is less reliable due to differences in construction, specifications, and materials, as well as the limited availability of PASER training for Michigan local agencies.

4.3 Application of Pavement Modeling to Qualifying Data Set

Roadsoft's pavement modeling functionality generated a unique performance model for each road segment in the qualifying data set. The performance model—comprised of an underlying pavement deterioration curve and a repair treatment curve—for each segment depended upon the segment's PASER scores and maintenance history data. Each of the unique performance models were reviewed individually, by hand, in order to verify that the results were reasonable and that the models fit the data well.

The ESL for each road segment was calculated as the time in years between curve and/or treatment application intersects with the CDP (PASER 4 line). In many cases, road segments received repair treatments prior to the pavement reaching its CDP (PASER 4 line); in these instances, the ESL was calculated as the time between the underlying pavement deterioration curve's theoretical intersection with the CDP and the repair deterioration curve's intersection with the CDP (see Figure 2). In cases where the pavement reached its CDP before receiving a repair treatment, the ESL was the time between the application of the repair treatment and the repair treatment curve's intersection with the CDP (Figure 5).

When there was an actual PASER 4 score following the repair treatment rather than just the modeled intersection, that rating point was considered as the end point for ESL measurement

regardless of where the repair treatment curve intersected the CDP (Figure 6). This was an additional conservative measure to eliminate modeling effects.

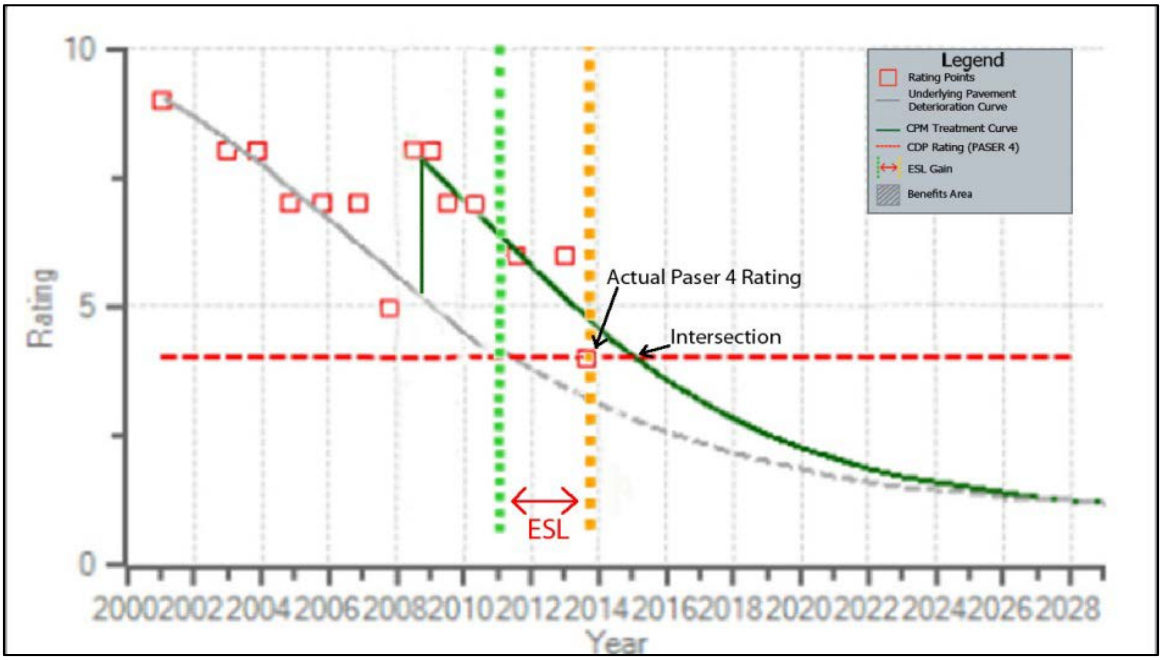

Figure 6: PASER 4 following repair treatment

Some repair treatment curves produced a negative ESL on paper when the curves intersected the CDP prior to the underlying pavement deterioration curve's intersection. It is assumed that a repair treatment will not negatively affect the life of the pavement but, in certain cases, may not provide an extended service life. Therefore, these performance models were classified as having an ESL equal to zero.

In some cases, the performance data indicated an ESL in excess of 15 years for heavy CPM treatments and 20 years for rehabilitation treatments. These ESLs are unexpected and outside the normal range of ESL for these treatment types. ESL was limited to a maximum of 15 years for heavy CPM treatments and a maximum of 20 years for rehabilitation treatments as a conservative measure to inhibit a few data points from skewing the entire data set (refer to the Discussion Topics section of this report for an explanation of limiting ESL for high performing segments and the sensitivity analysis of this decision).

Data was analyzed for each qualifying treatment category by agency, and then at a statewide level. ESL was assigned to each treated road segment meeting the selection criteria; these individual segment ESLs combined to create a weighted average using the length in miles of each segment as the weighting factor, which accounts for variation in segment lengths. Weighted average ESL was calculated for each treatment and each agency as well as an overall weighted average ESL for the state by treatment type. This data set was further segments by legal system classification (e.g., county primary, city major), National Functional Classification

(NFC), number of lanes, and by region in order to identify any common trends. The Cochran Formula was used to estimate sample sizes necessary to produce ESL results with a margin of error of 15% based on an estimate of the parent population. Required sample sizes ranged from 35 miles for relatively rare treatments like cape seal which have a small population size, to 43 miles for common treatments like chip seal that have a very large population size. The use of miles of treatment as a sample size estimator was considered to be conservative, since there are likely several separate observations per mile which tend to lower the required sample size.

5 RESULTS

Thirty-six agencies submitted data for consideration of use in this study. The analyzed data included 51,645 road segments, which consisted of 10,578.360 road miles (17,024.220 kilometers)—or 12% of Michigan's paved Federal-aid network)—that met the following criteria in Roadsoft:

- Act 51 equals true
- Sub Base equals Asphalt Standard (one agency used Asphalt)

Of the originally submitted data pool, 29 agencies' data met the selection criteria defined in the Methods section of this report. The application of the selection criteria resulted in 6,236 road segments—or 1,709.774 miles (2,751.615 kilometers) of road data—that had qualifying repair treatments. The seven agencies whose data did not meet selection criteria comprised a significant amount of data. Reasons for excluding their data included segment data pertained to pavements constructed and treated prior to 2000 (see maximum age selection criterion in the Methods section) and segment data pertained to pavements with successive repair treatments of the same TAMC classification (see discussion about diminishing returns in the Methods section).

The 29-agency data pool produced 14 discrete treatments that met the selection criteria for analysis. Table 2 summarizes these treatments. Six of the 14 treatments— cape seal, chip seal, chip seal plus fog, thin overlay, crush and shape, and thick overlay—has significantly large enough sample sizes to produce a sound statewide average ESL.

Only two agencies, in close proximity to each other, used cape seal; so this data is representative of local or regional level rather than at a state level. A larger number (10-25) of agencies used the other five treatments and covered a more diverse portion of the qualifying road network statewide, so these data are representative at a statewide level.

Table 2: Summary of Extended Service Life by Treatment Type

Treatment	Agencies	Segment Count	Total Miles	Weighted Avg ESL
Heavy CPM				
Cape seal	2	**260**	**35.042**	6.0
Chip seal	**21**	**2372**	**784.858**	**4.1**
Chip seal plus fog seal	**10**	**514**	**195.890**	**7.1**
Microsurface	3	129	26.679	2.3
Slurry seal	1	20	1.999	3.7
Thin overlay	**20**	**666**	**161.899**	**6.9**
Rehabilitation				
Cold-in-place (CIP) plus overlay	1	7	2.092	6.1
Crush and Shape	**10**	**453**	**142.537**	**11.3**
Hot-in-place (HIP)	1	12	1.349	11.1
HIP plus overlay	2	15	2.095	7.3
HMA wedge plus chip seal	1	13	5.060	4.6
HMA wedge plus overlay	4	58	25.003	5.7
Thick overlay	**25**	**1584**	**301.760**	**9.1**
Reconstruction				
Reconstruction	6	133	23.511	9.9
Total	**29**	**6236**	**1709.774**	

5.1 Cape Seal

Cape seal treatments meeting the selection criteria totaled 35.042 miles (56.394 kilometers) (Figure 7). Cape seal is a relatively new treatment in Michigan, and records from the TAMC Investment Reporting Tool (IRT) indicate that only 46 miles of this treatment were applied in 2017 on local agency owned roads. In the data set two agencies indicated use of cape seal; their total segment count was 260. The weighted average ESL for this regional data set was 6.0 years. It is interesting to note that only 0.58 miles (0.93 kilometers) of cape seal resulted in a zero ESL improvement. This may be due to the limited amount of agencies in the data set, or to the increased care these agencies use in selecting locations for cape seals.

Figure 7 shows a fairly-uniform bell-curve shaped distribution with the most frequently observe cohort of seven years of ESL. This is indicative of a normally distributed data set. The box plot of this data is depicted in Figure 8 which illustrates the distribution of data points. The non-weighted average is represented as a blue line and the median is represented as a black line in Figure 8 The left side of Figure 8's black skeletal box plot represents the first quartile, the center is the median, and the right side is the third quartile. Black tick marks represent the minimum and maximum on the left and right side, respectively. The black dashed-line area illustrates the 95% confidence interval containing the median; the blue dashed-line area is the 95% confidence interval containing the unweighted average. The blue dashed-line area centers over the unweighted average. Since these data points are not weighted by miles, the box plot and mean plot will show a skew due to segment length.

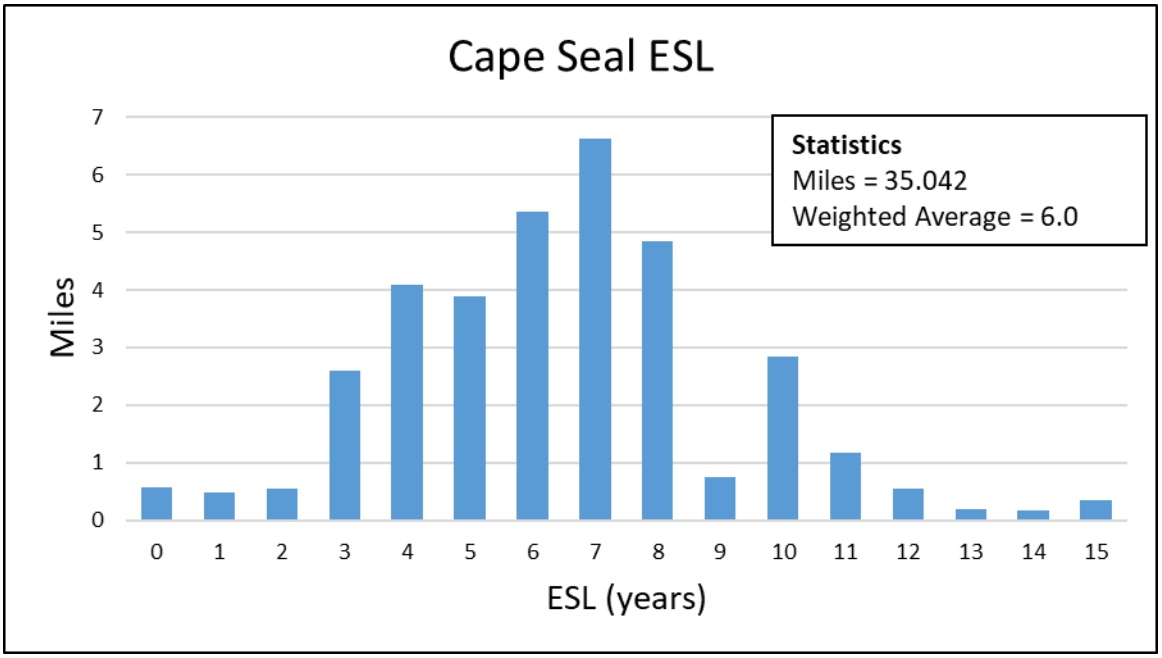

Figure 7: Cape seal qualifying miles distribution by ESL

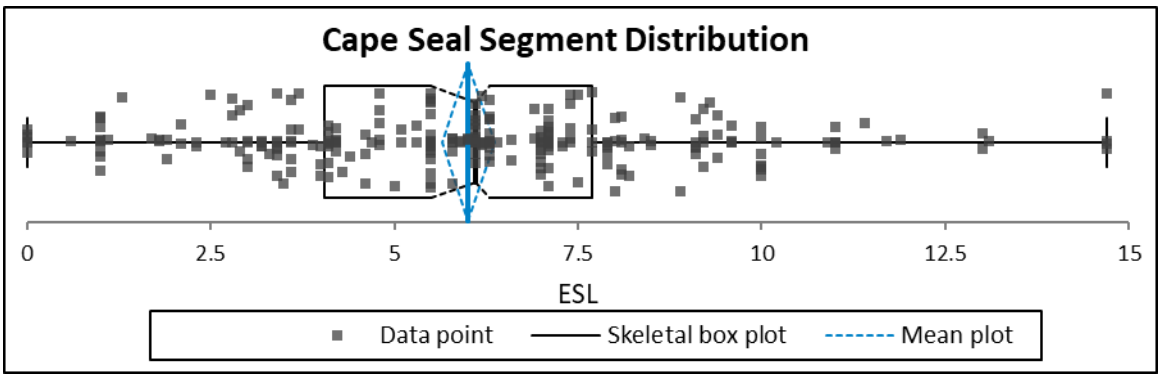

Figure 8: Cape seal non-weighted average ESL segment distribution

5.2 Chip Seal

Chip seal was the most prevalent repair treatment in the data set. Chip seal prevalence is likely due to chip seals' long-time use in the United States and, thus, the good understanding that agencies have of chip seal treatment as well as the ability local agencies have to apply it with minimal equipment, work forces, and cost. Treatments such as slurry seal, microsurface, and cape seal are newer and offer attractive aesthetic properties but cost considerably more, and most studies have shown that they have similar performance lives to chip seal.

As Table 2 indicates, chip seals meeting the selection criteria totaled 784.858 miles (1,263.107 kilometers). Twenty-one agencies indicated use of chip seal; their total segment count was 2,372. A fairly-uniform trend in a histogram plot of increasing ESL values indicates that ESL gains of over 9 years are uncommon and ESL gains between 0 and 7 years are frequent (Figure 9). This data set did have 114.59 miles (184.415 kilometers) with an ESL gain of zero, which is depicted as 364 segments in Figure 10. The weighted average ESL for the data set was 4.1 years and is the same weighted average that was found in the 2014 ESL study (Colling, Keifer, & Farrey; 2014) using different data sets and different local agencies. This weighted average accounts for instances where no ESL was gained by the treatment.

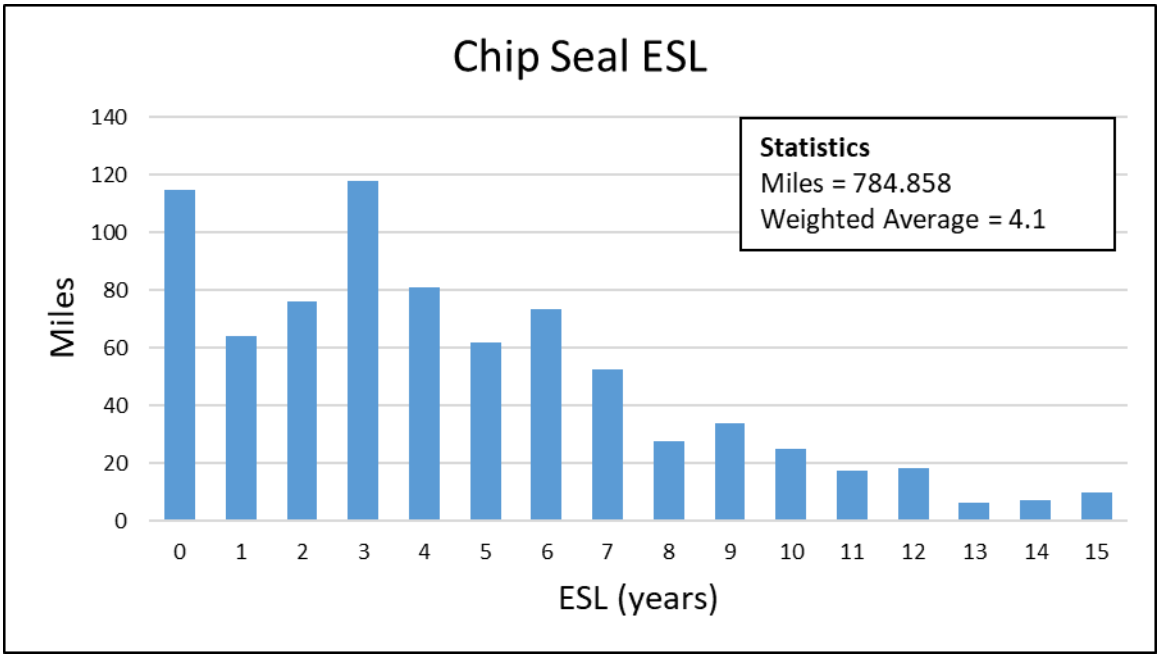

Figure 9: Chip seal qualifying miles distribution by ESL

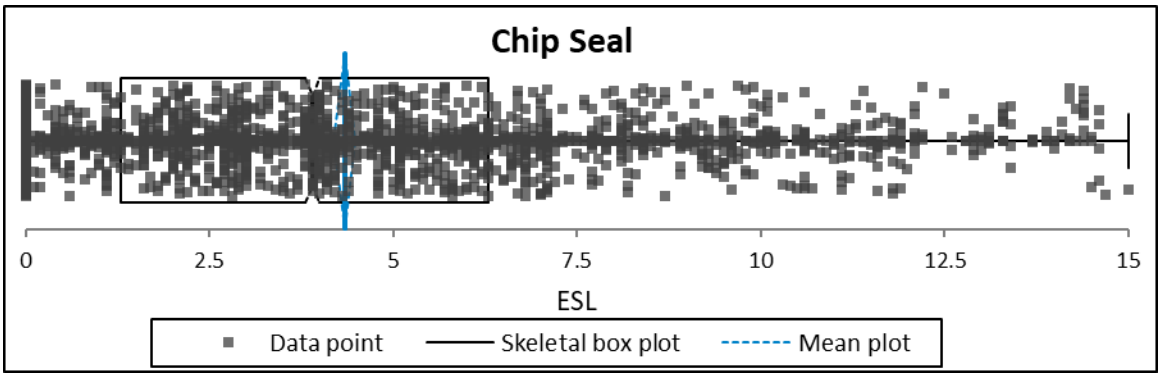

Figure 10: Chip seal non-weighted average ESL segment distribution

5.3 Chip Seal *Plus* Fog Seal

This combination treatment was specifically identified in the data set and analyzed separately. Chip seal plus fog seal treatments that met the selection criteria totaled 195.890 miles (315.254 kilometers) (Figure 11). Ten agencies included this treatment as a distinct data set; with a total segment count of 514. Figure 11 shows a total of 44.769 miles (72.049 kilometers)of chip seal plus fog seal that have over 10 years of ESL, which is 22.8% of this data set. Another interesting find is that there is only 0.222 miles (0.357 kilometers) with zero ESL gain, which is significantly lower than standard chip seals. The weighted average ESL for the data set was 7.1 years. Of the six significant treatments, chip seal plus fog seal had the most change in ESL after adjusting for skew due to segment size; this can be shown when comparing the weight average of 7.1 years to the non-weighted average of 6.4 years. Figure 12 shows the non-weighted data points for chip seal plus fog seal treatment.

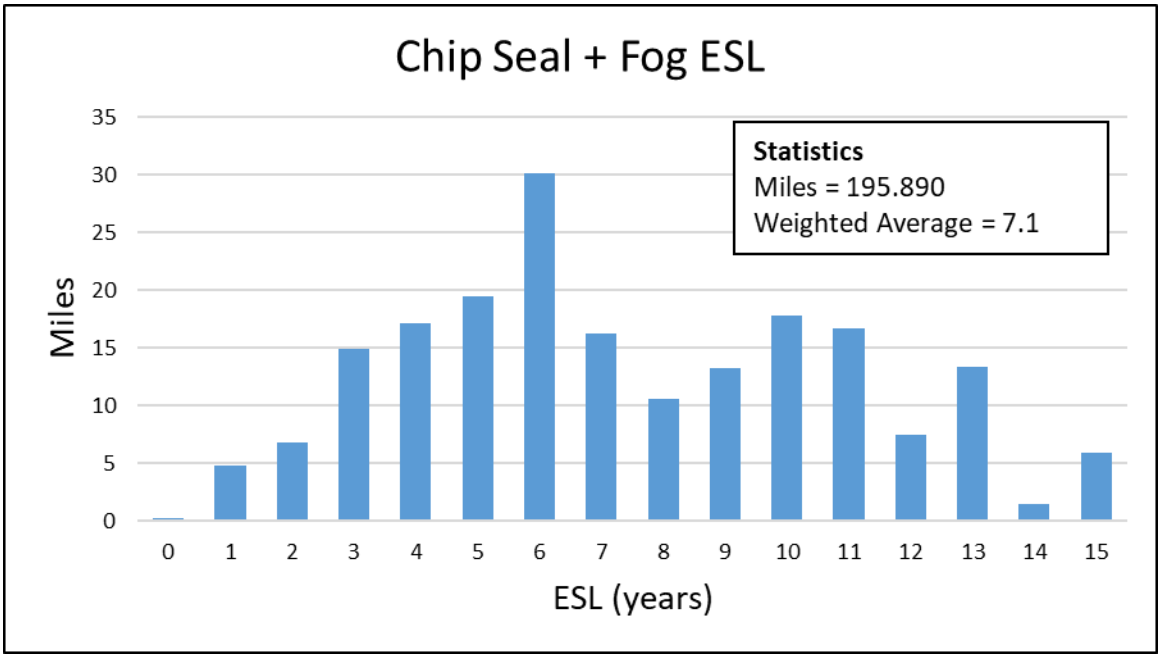

Figure 11: Chip seal plus fog seal qualifying miles distribution by ESL

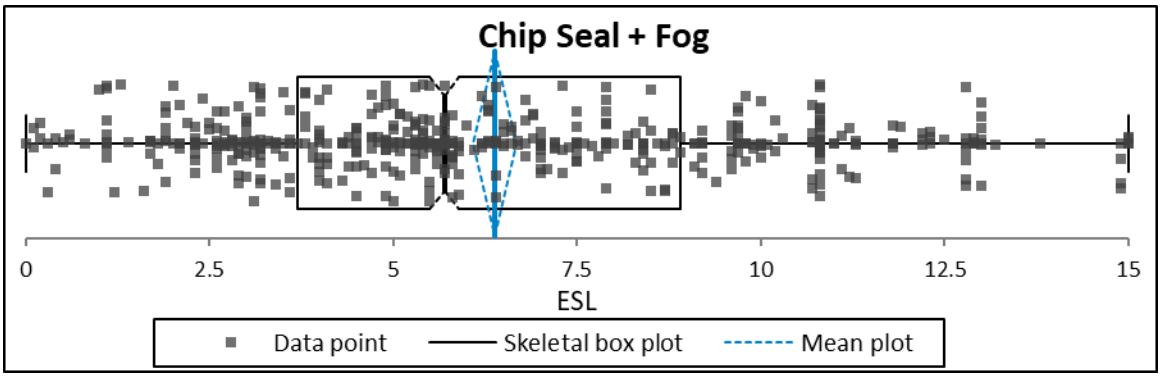

Figure 12: Chip seal plus fog seal non-weighted average ESL segment distribution

An interesting finding was the increased ESL for placing a fog seal on top of a chip seal. Twenty-one agencies used chip seal alone and had a weighted average ESL of 4.1 years. Ten agencies used chip seal plus fog seal and had a weighted average ESL of 7.1 years; nine of these agencies used both chip seal and chip seal plus fog seal. The nine agencies were analyzed separately to minimize uncontrollable factors influencing treatment life (Figure 13 and Table 3). Applying the Student's *t*-test analysis to the central tendency of the two treatments—chip seal and chip seal plus fog seal—used by these nine agencies revealed that their average ESL gains are statistically significant. This means that there are differences in the central tendency (average ESL) for both of these treatments that is not a result of the variability of the data. The non-weighted average ESL gain for chip seal plus fog seal was 1.7 while the weighted average ESL gain was 2.9 years.

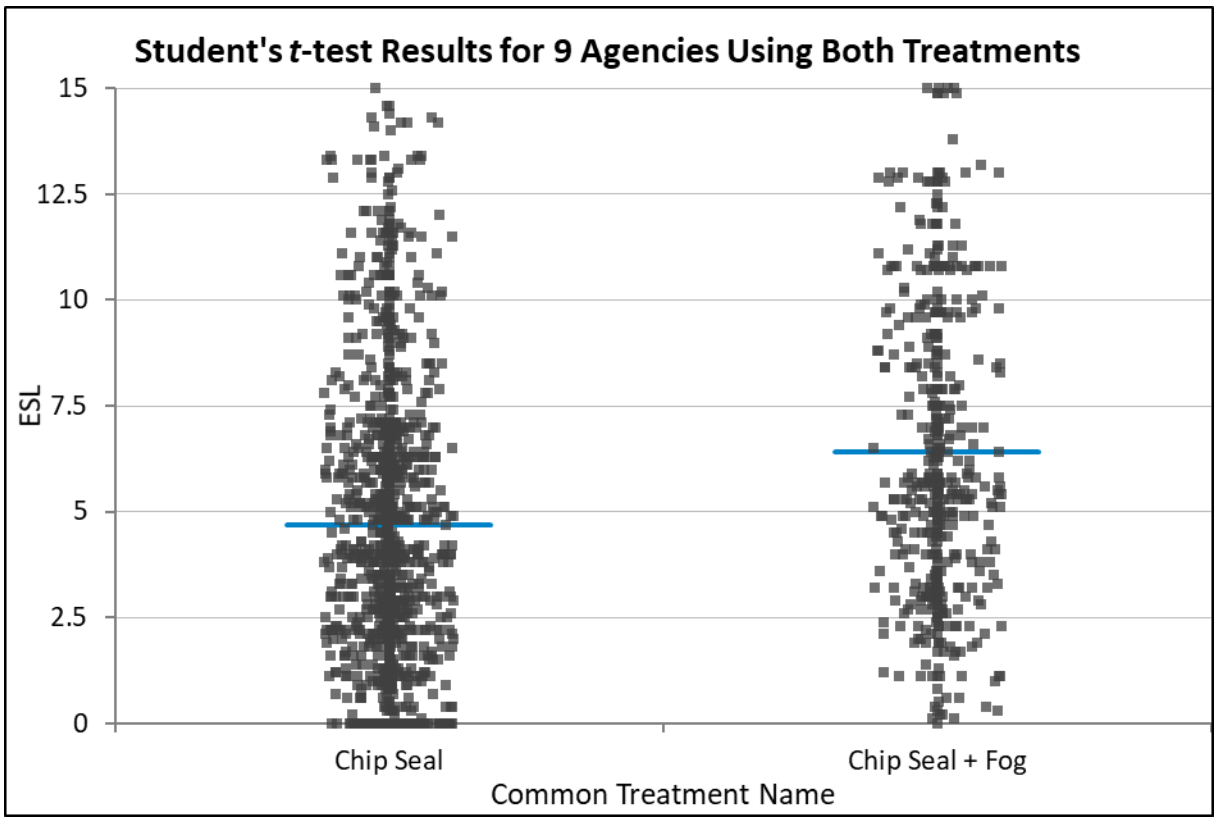

Figure 13: Chip seal vs. chip seal plus fog seal non-weighted average ESL segment distribution

Table 3: Nine Agencies that use Both Chip Seal and Chip Seal Plus Fog Seal

ESL by Common Treatment Name	n	Mean (not weighted)	Mean SE	SD
Chip seal	1265	4.68	0.091	3.24
Chip seal plus fog seal	509	6.40	0.151	3.41
Mean difference	1.72			
SE	0.173			
Student's *t* test				
Hypothesized difference	0		DF	1772[1]
t statistic	9.95		*p*-value	<0.0001

[1] Reject the null hypothesis in favor of the alternative hypothesis at the 10% significance level.

5.4 Microsurface

Microsurface treatment meeting the selection criteria totaled 26.679 miles (42.936 kilometers) (Figure 14). Three agencies indicated use of microsurface; their total segment count was 129. The weighted average ESL for the limited data set was 2.3 years, however, this average ESL has an unacceptable margin of error due to the small number of segments available for analysis making the results inconclusive. Figure 15 shows the non-weighted average ESL median as 2.4 years and the mean as 2.9 years. The 2014 ESL study calculated a weighted average ESL of 5.4 years from a 7.9-mile (12.7-kilometer) data set (Colling, Kiefer, & Farrey; 2014). Whereas the 2014 study analyzed only one agency, this study analyzed three agencies' microsurface treatment segments. Both studies did not contain large enough sample sizes for microsurfacing to draw conclusions about the effectiveness of this treatment.

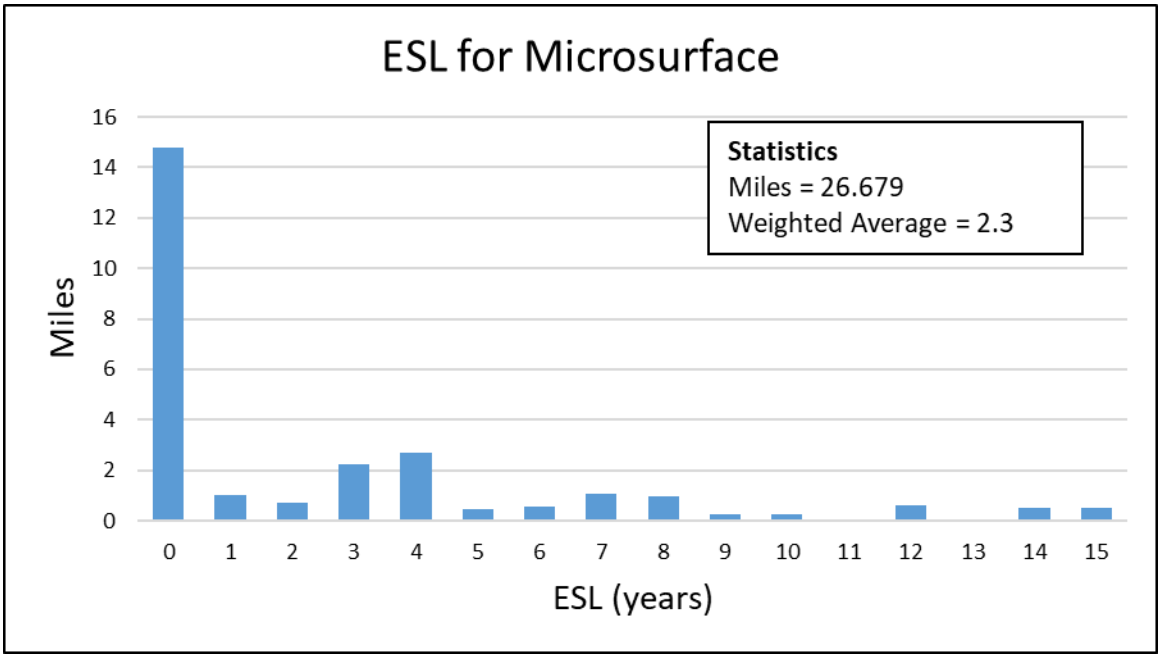

Figure 14: Microsurface qualifying miles distribution by ESL

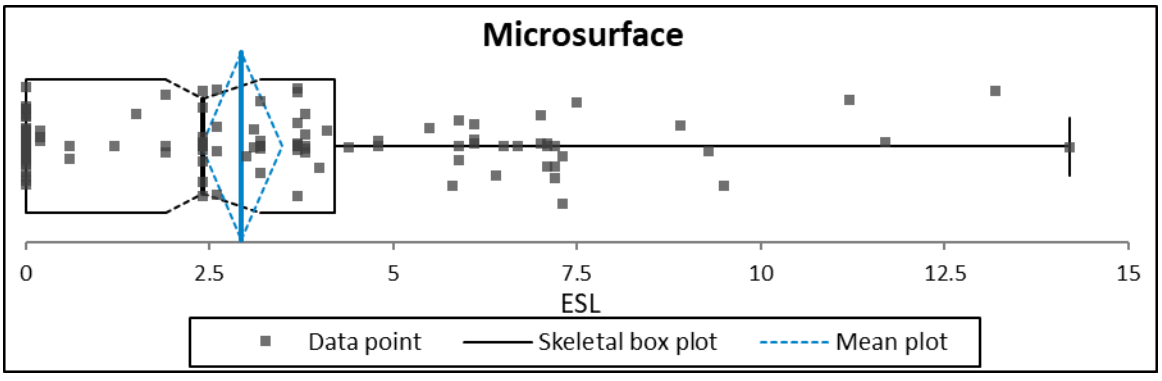

Figure 15: Microsurface non-weighted average ESL segment distribution

5.5 Slurry Seal

Slurry seal treatments meeting the selection criteria totaled 1.999 miles (3.217 kilometers) (Figure 16). One agency indicated use of slurry seal; their total segment count was 20. The weighted average ESL for the limited data set was 3.7 years, however, this average ESL has an unacceptable margin of error due to the small number of segments available for analysis making the results inconclusive (Figure 17).

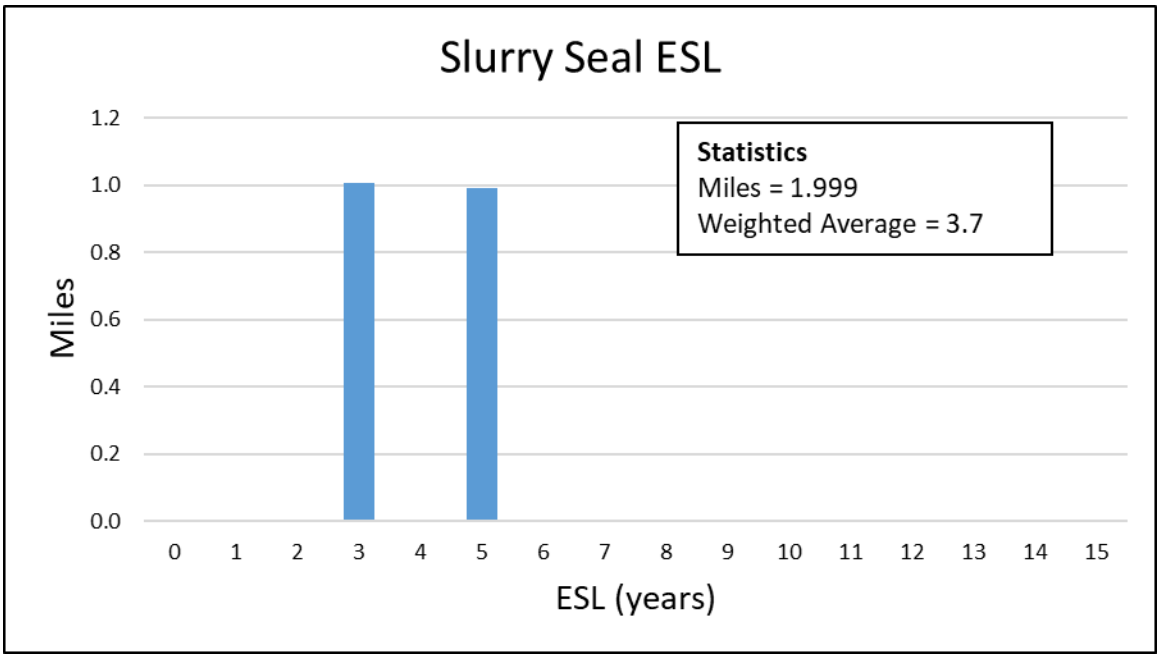

Figure 16: Slurry seal qualifying miles distribution by ESL

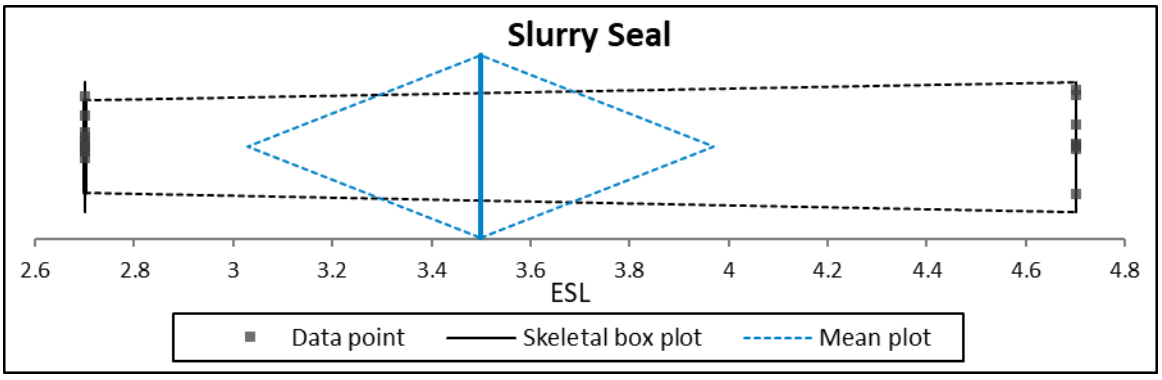

Figure 17: Slurry seal non-weighted average ESL segment distribution

5.6 Thin Overlay

Thin overlay treatments meeting the selection criteria totaled 161.899 miles (260.551 kilometers) (Figure 18). Twenty agencies indicated use of thin overlay; their total segment count was 666. The weighted average ESL for the data set was 6.9 years. There were 8.071 miles (12.989 kilometers)—or 21 segments—having more than 15 years of ESL (ESL ranging from 16 to 36 years) and a weighted average ESL of 18.7 years; these segments were excluded from Figure 19. There could be many reasons (e.g. agency policy, traffic volumes, and, underlying distresses, more careful selection criteria) why the chip seal plus fog achieved a higher ESL weighted average as compared to thin overlay treatments, which could only be identified with a more intensive study.

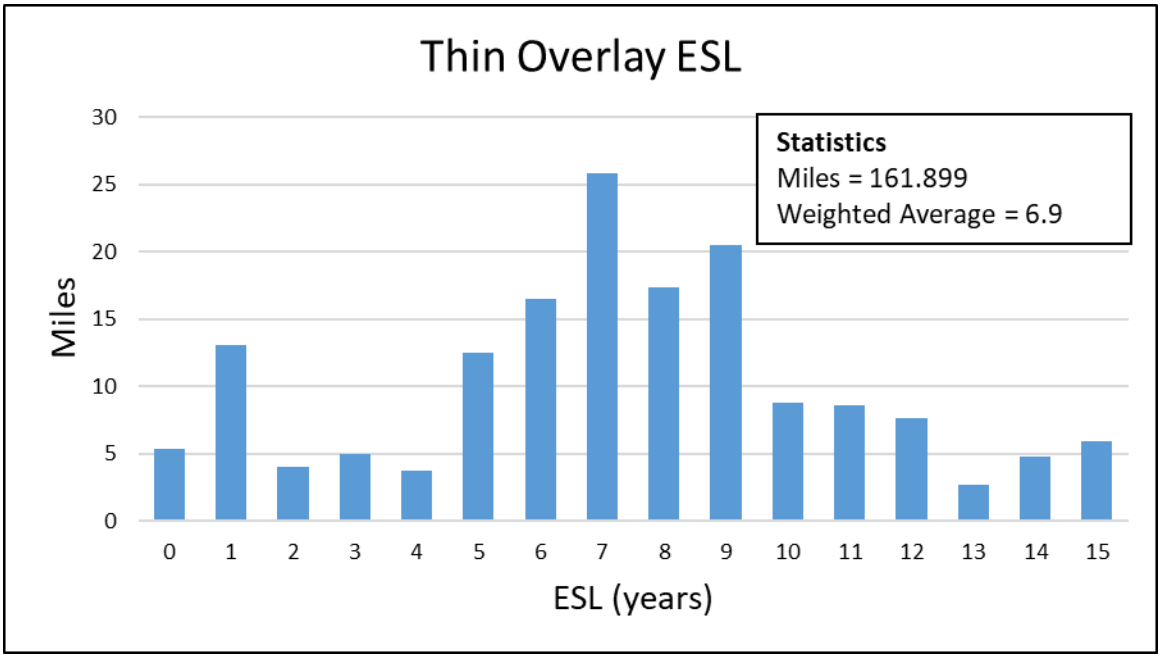

Figure 18: Thin overlay qualifying miles distribution by ESL

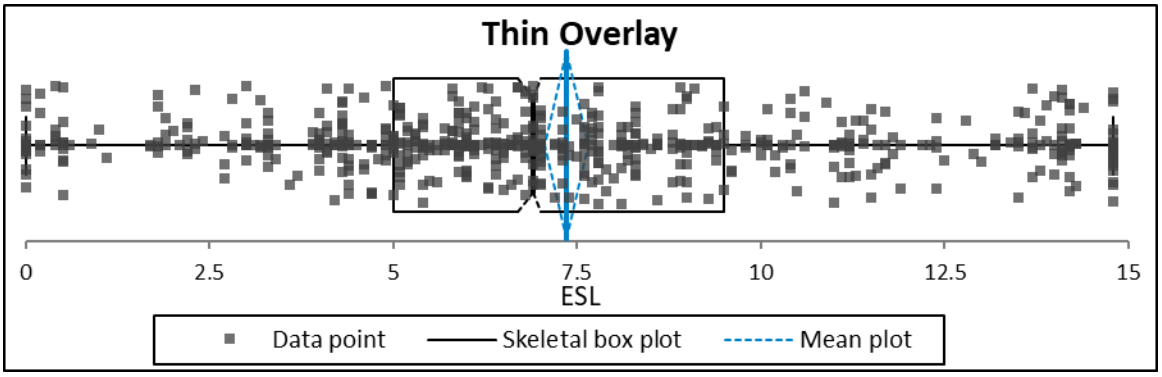

Figure 19: Thin overlay non-weighted average ESL segment distribution

5.7 Cold-in-Place *Plus* Overlay

Cold-in-place (CIP) plus overlay treatments meeting the selection criteria totaled 2.092 miles (3.367 kilometers) (Figure 20). One agency indicated use of CIP plus overlay; their total segment count was 7. The weighted average ESL for the limited data set was 6.1 years, however, this average ESL has an unacceptable margin of error due to the small number of segments available for analysis making the results inconclusive (Figure 21).

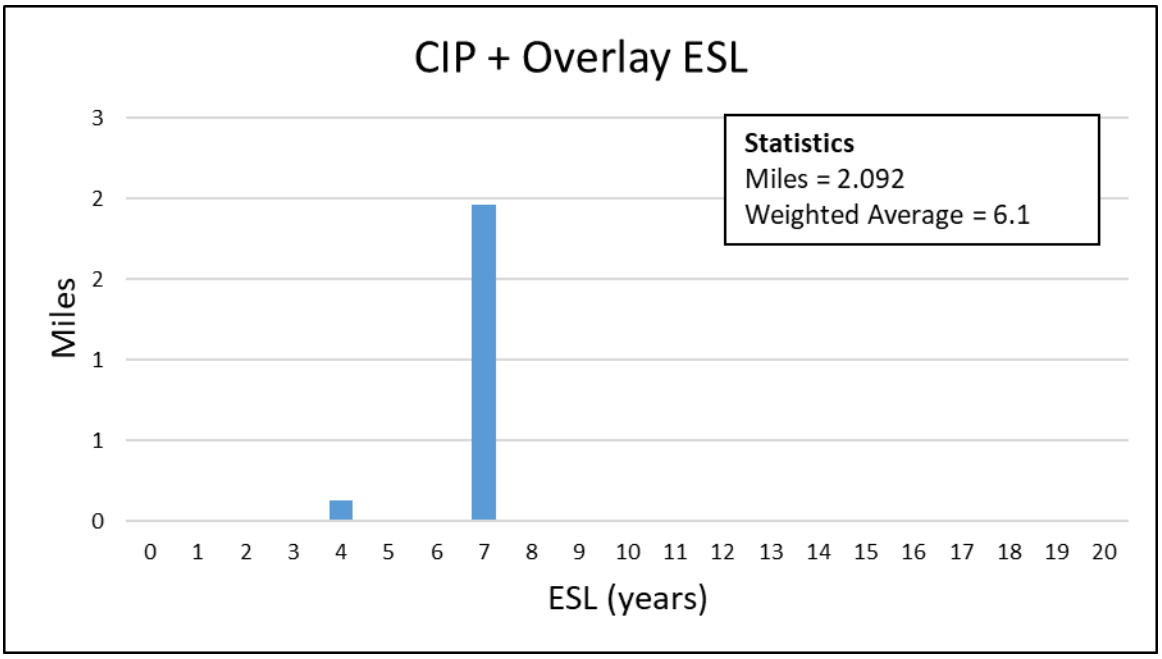

Figure 20: CIP plus overlay qualifying miles distribution by ESL

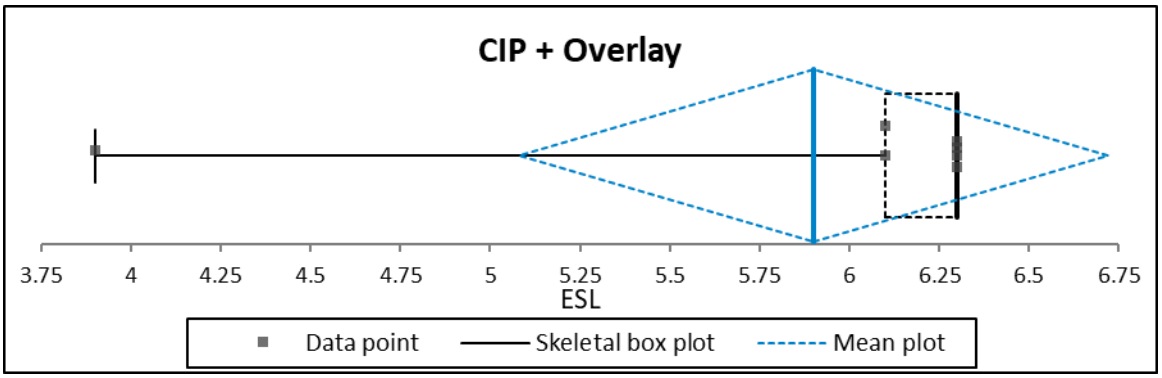

Figure 21: CIP plus overlay non-weighted average ESL segment distribution

5.8 Crush and Shape

Crush-and-shape treatments meeting the selection criteria totaled 142.537 miles (229.391 kilometers) (Figure 22). Ten agencies indicated use of crush and shape; their total segment count was 453. The weighted average ESL for the data set was 11.3 years (Figure 23).

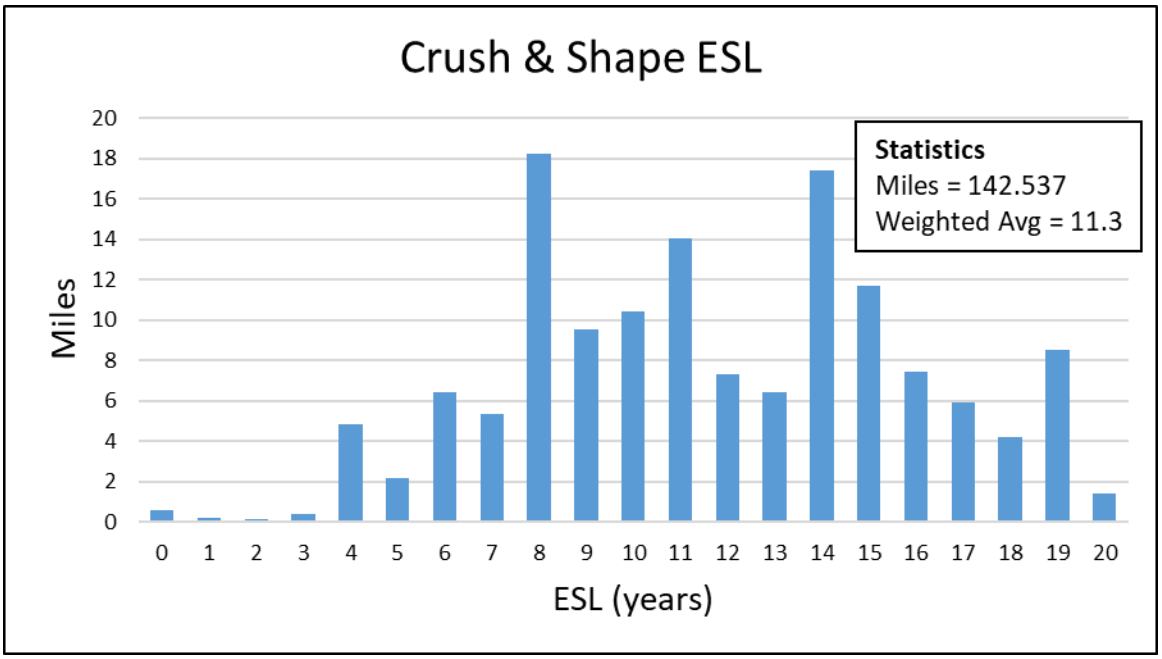

Figure 22: Crush and shape qualifying miles distribution by ESL

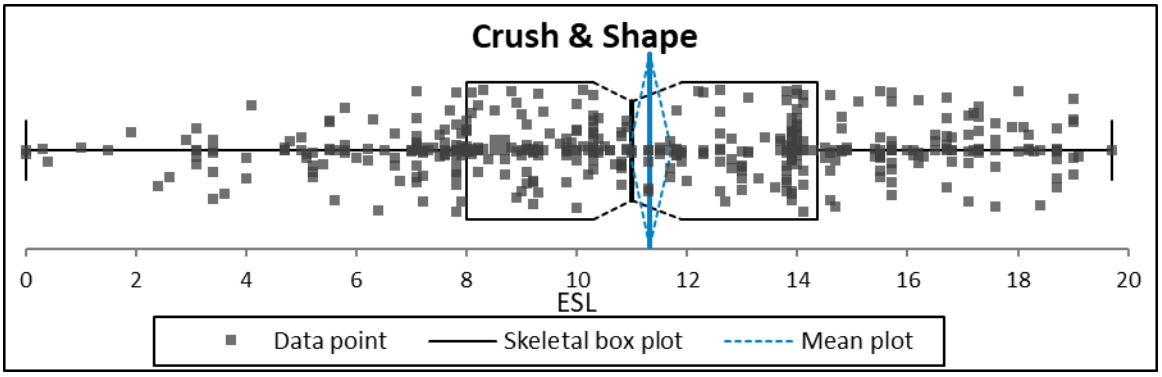

Figure 23: Crush and shape non-weighted average ESL segment distribution

5.9 Hot-in-Place

Hot-in-place (HIP) treatments meeting the selection criteria totaled 1.349 miles (2.171 kilometers) (Figure 24). One agency indicated use of HIP; their total segment count was 12. The weighted average ESL for the limited data set was 11.1 years, however, this average ESL has an unacceptable margin of error due to the small number of segments available for analysis making the results inconclusive (Figure 25).

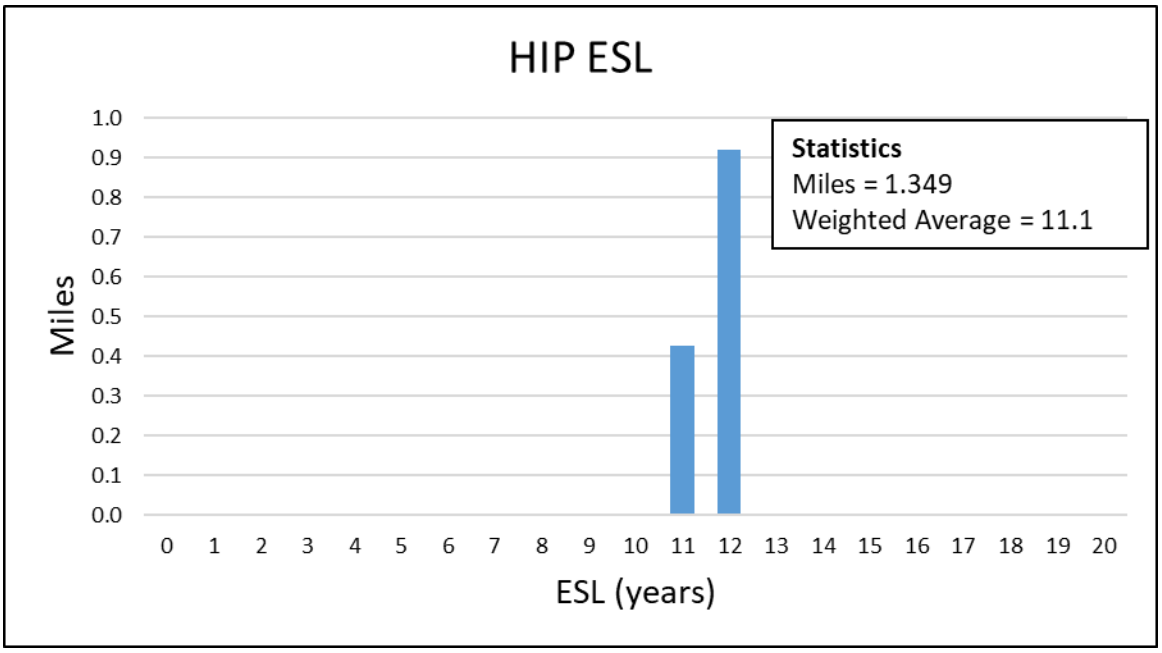

Figure 24: HIP qualifying miles distribution by ESL

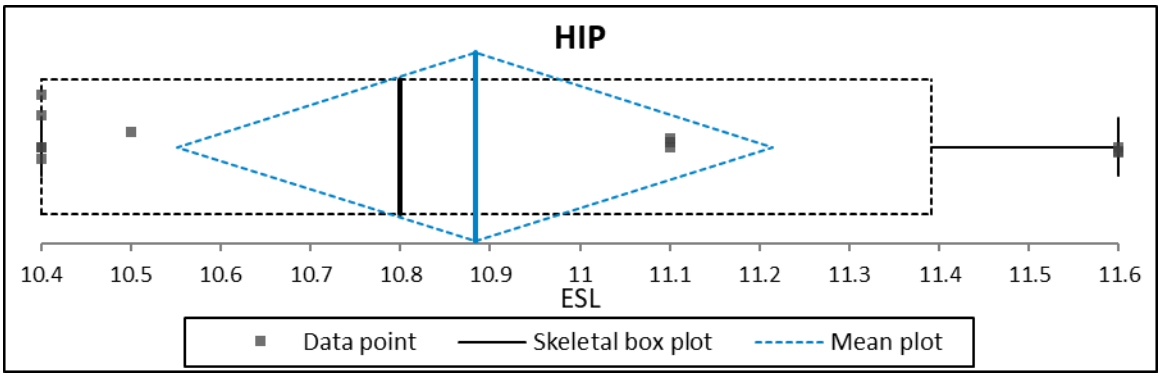

Figure 25: HIP non-weighted average ESL segment distribution

5.10 Hot-in-Place *Plus* Overlay

Hot-in-place (HIP) plus overlay treatments meeting the selection criteria totaled 2.095 miles (3.372 kilometers) (Figure 26). Two agencies indicated use of HIP plus overlay; their total segment count was 15. The weighted average ESL for the limited data set was 7.3 years, however, this average ESL has an unacceptable margin of error due to the small number of segments available for analysis making the results inconclusive (Figure 27).

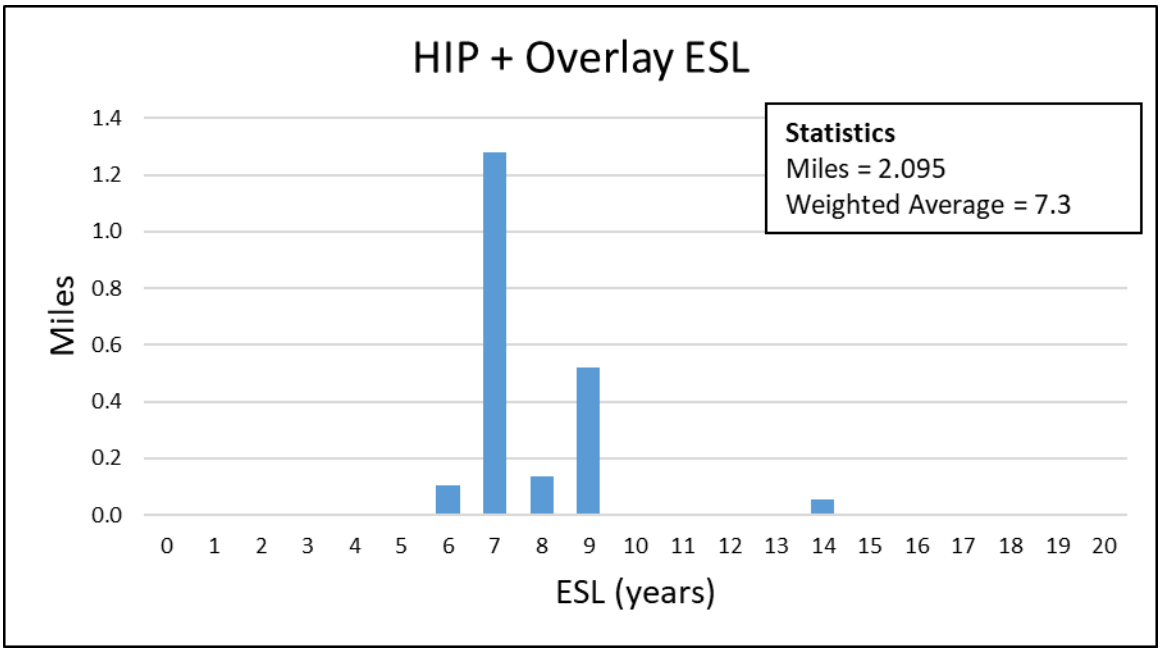

Figure 26: HIP plus overlay qualifying miles distribution by ESL

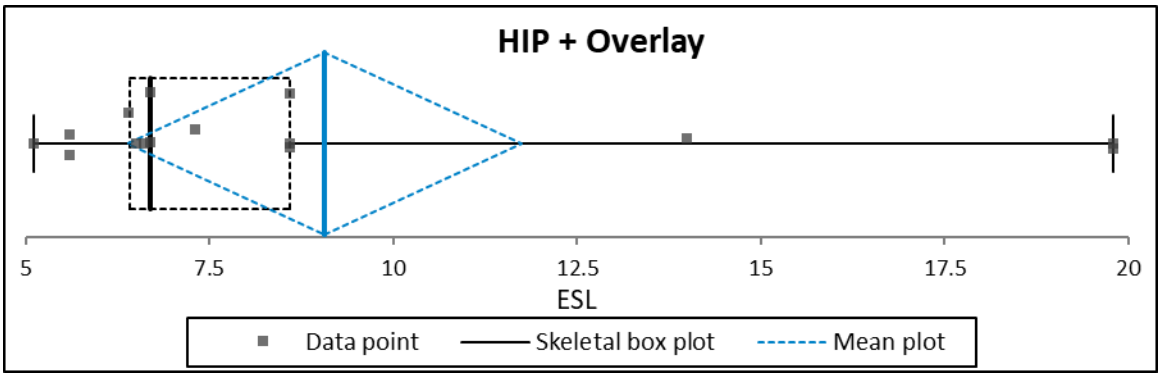

Figure 27: HIP plus overlay non-weighted average ESL segment distribution

5.11 Hot-mix-asphalt Wedge *Plus* Chip Seal

Hot-mix-asphalt (HMA) wedge plus chip seal treatments meeting the data selection criteria totaled 5.060 miles (8.143 kilometers) (Figure 28). One agency indicated use of HMA wedge plus chip seal; their total segment count was 13. The weighted average ESL for the limited data set was 4.6 years, however, this average ESL has an unacceptable margin of error due to the small number of segments available for analysis making the results inconclusive (Figure 29).

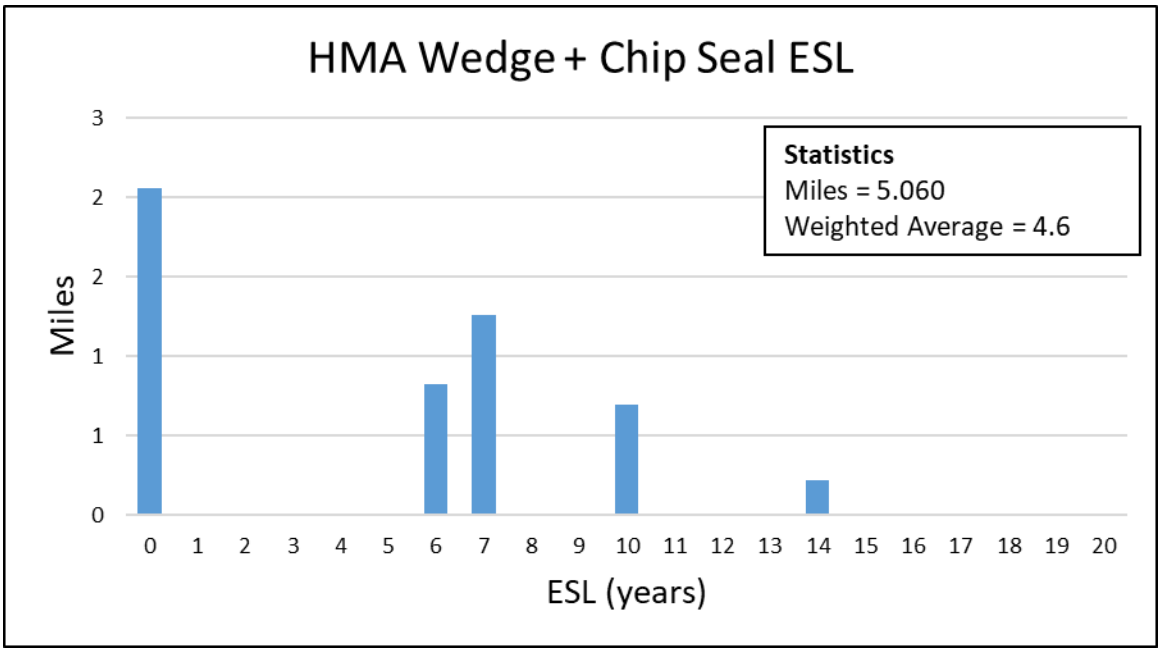

Figure 28: HMA wedge plus chip seal qualifying miles distribution by ESL

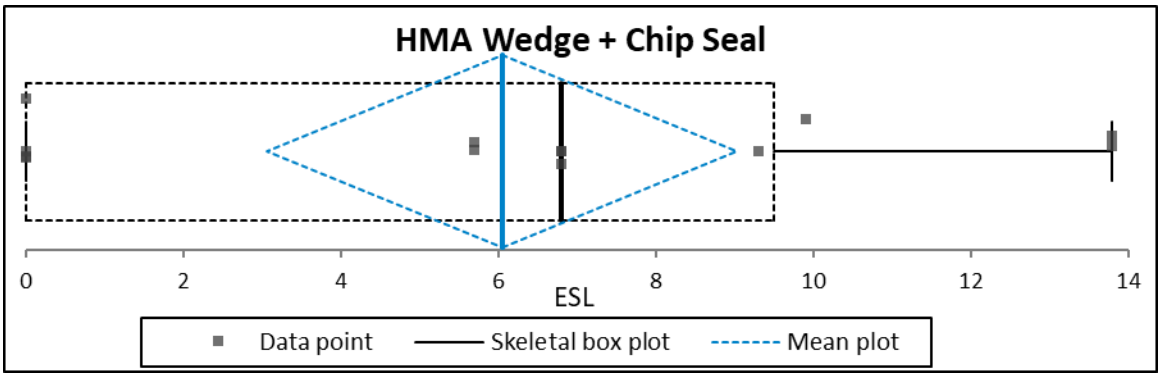

Figure 29: HMA wedge plus chip seal non-weighted average ESL segment distribution

5.12 Hot-mix-asphalt Wedge *Plus* Overlay

Hot-mix-asphalt (HMA) wedge plus overlay treatments meeting the data selection criteria totaled 25.003 miles (40.238 kilometers) (Figure 30). One agency indicated use of HMA wedge plus overlay; their total segment count was 58. The weighted average ESL for the limited data set was 5.7 years, however, this average ESL has an unacceptable margin of error due to the small number of segments available for analysis making the results inconclusive. (Figure 31).

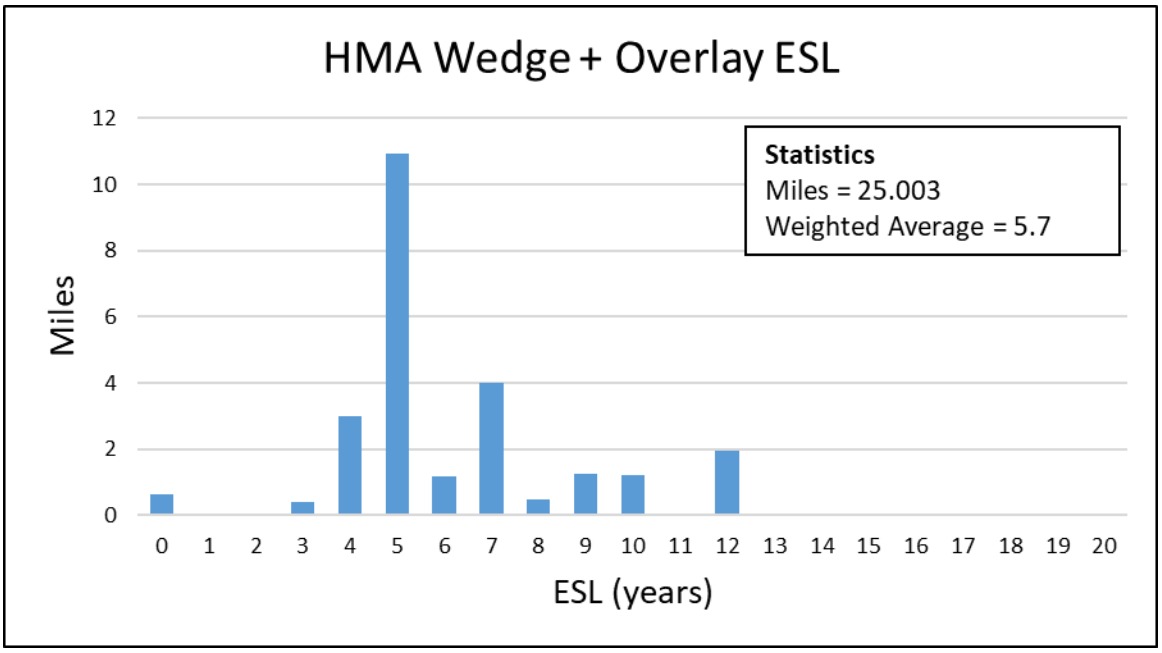

Figure 30: HMA wedge plus overlay qualifying miles distribution by ESL

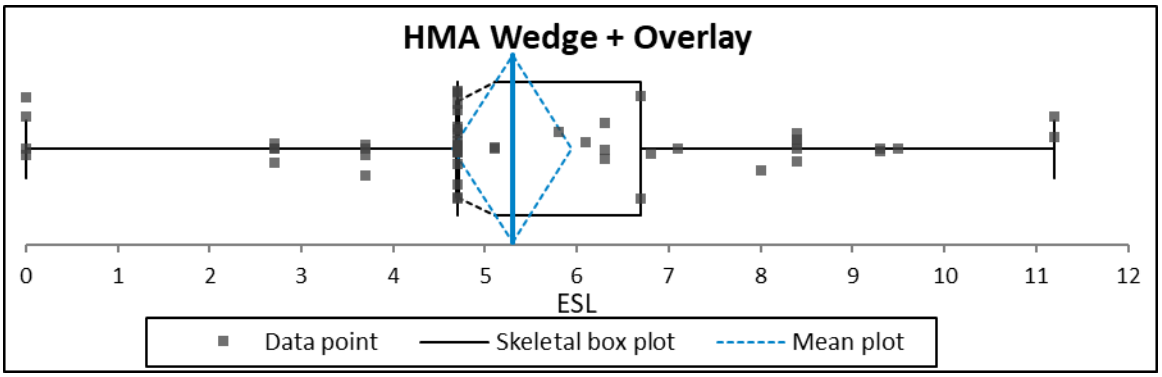

Figure 31: HMA wedge plus overlay non-weighted segment distribution

5.13 Thick Overlay

Thick overlay treatments meeting the data selection criteria totaled 301.760 miles (485.636 kilometers) (Figure 32). Twenty-five agencies indicated use of thick overlay; their total segment count was 1,584 (Figure 33). The weighted average ESL for the data set was 9.1 years. The thicknesses of the reported thick overlay treatments ranged from 1.75 to 5 inches (4.4 to 12.7 centimeters); a general trend showed an ESL gain as the thickness increased, which is what would be expected.

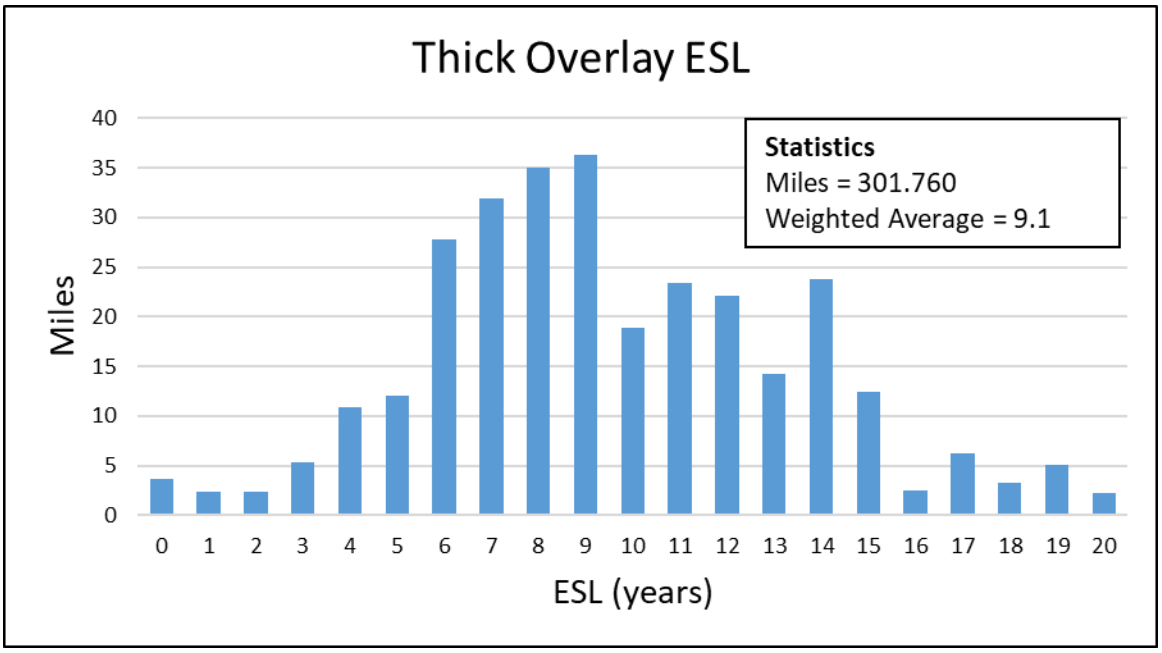

Figure 32: Thick overlay qualifying miles distribution by ESL

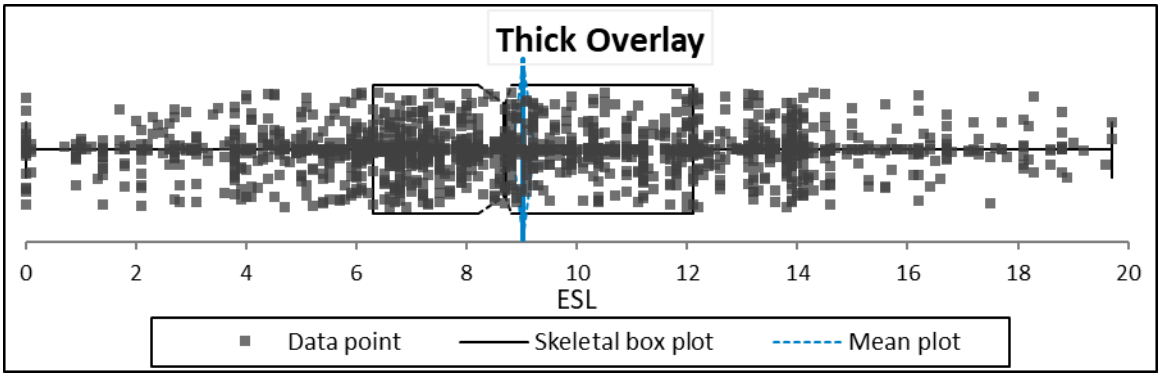

Figure 33: Thick overlay non-weighted average ESL segment distribution

5.14 Reconstruction

Reconstruction meeting the data selection criteria totaled 23.511 miles (37.837 kilometers) (Figure 34). Six agencies indicated use of reconstruction; their total segment count was 133. The HMA thickness layer of these reconstruction projects ranged from 1.5 to 3 inches (3.8 to 7.6 centimeters). This may help explain why the thicker HMA layers used in thick overlay treatments obtained a higher ESL value than the estimated service life of reconstruction. The estimated service life was used instead of extended service life because a reconstruction project creates a brand new pavement structure. The weighted average estimated service life for the limited data set was 9.9 years, however, this average has an unacceptable margin of error due to the small number of segments available for analysis making the results inconclusive (Figure 35). This data set included a large number of segments that were recently constructed, which limited the number of late age data points in this data group. As a result, the estimated service life calculated from this data is inconclusive.

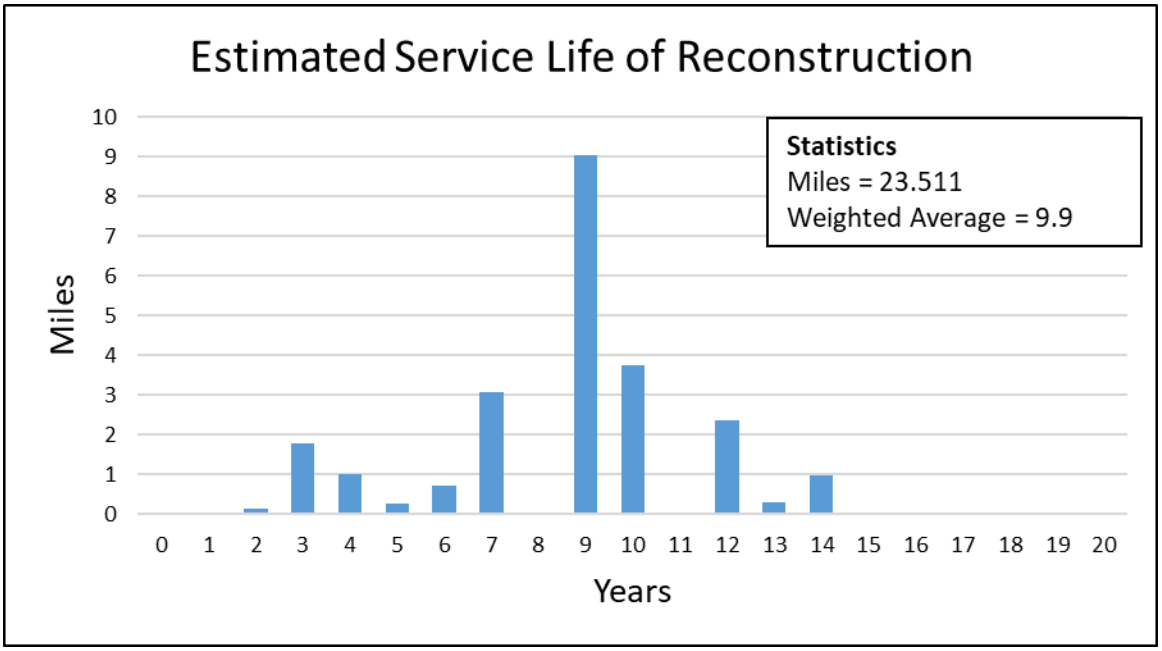

Figure 34: Reconstruction qualifying miles by estimated service life distribution

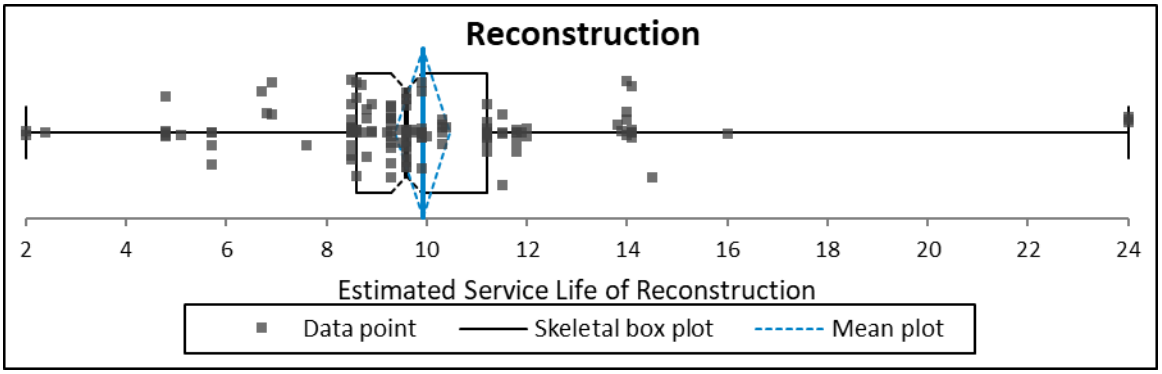

Figure 35: Reconstruction non-weighted average estimated service life segment distribution

5.15 Data Set Breakdowns for Analyses

Data sets were subdivided by different classification systems in order to analyze trends, identify and eliminate sampling biases, and compare and contrast the findings. Data sets were divided as follows:

5.15.1 By Legal System Classification

Examining the data based on the legal system classification aimed to facilitate analysis and to identify and eliminate sampling bias for differences in agencies' road classifications, which are maintained through agency-specific policies. The legal system classification breaks down the data set road miles (and segments) into county local, county primary, city major, city minor, and state trunkline. Federal-aid routes were isolated as a unique data set. In the Federal-aid-route dataset, (94.96%) were county primary. Table 4 summarizes mileage breakdown by legal classification and treatment class. There were too few miles (and segments) classified in the non-'county primary' categories to make determinations on differences for most of the treatment classes. The 1.444 miles (2.323 kilometers) marked as "State Trunkline" or "N/A" appeared to be mislabeled route(s).

Table 4: Mileage Breakdown by Legal Classification System and Treatment Class

Treatment Class	County Local	County Primary	City Major	City Minor	State Trunkline	N/A
Heavy CPM	4.824	1157.198	43.9	0.445	-	-
Rehabilitation	6.134	438.764	33.319	0.235	1.054	0.39
Reconstruction	-	15.241	8.27	-	-	-
Total	**10.958**	**1611.203**	**85.489**	**0.68**	**1.054**	**0.39**

5.15.2 By National Function Class

Examining the data based on national function class (NFC) aims to identify and eliminate sampling bias for differences in agencies' road classifications, which are maintained through agency-specific policies. The NFC breaks down the data set road miles (and segments) into major collector, minor arterial, minor collector, and principal arterial. Table 5 summarizes the mileage breakdown by NFC and treatment class. The 0.39 miles (0.628 kilometers) marked as "N/A" appeared to be mislabeled route(s).

Table 5: Mileage Breakdown by National Function Class and Treatment Class

Treatment Classification	Major Collector	Minor Arterial	Minor Collector	Principal Arterial	N/A
Heavy CPM	984.405	207.322	3.404	11.236	-
Rehabilitation	323.225	132.518	0.091	23.672	0.39
Reconstruction	11.732	10.709	-	1.07	-
Total	**1319.362**	**350.549**	**3.495**	**35.978**	**0.39**

When broken down by NFC, all of the treatment classes either showed no difference in ESL or had too few miles (and segments) to make determinations on differences for treatments with the exception of thick overlay treatment. For thick overlay treatment distributed by NFC, the classifications of major collector, minor arterial, and principal arterial had enough miles (and segments) to be considered statistically significant (Figure 36). The weighted average ESLs are 9.4 years for major collectors, 8.4 years for minor arterials, and 10.2 years for principal arterial. The principle arterial median data has a higher variability (Figure 36); therefore, this data set should be considered less reliable than major collector and minor arterial.

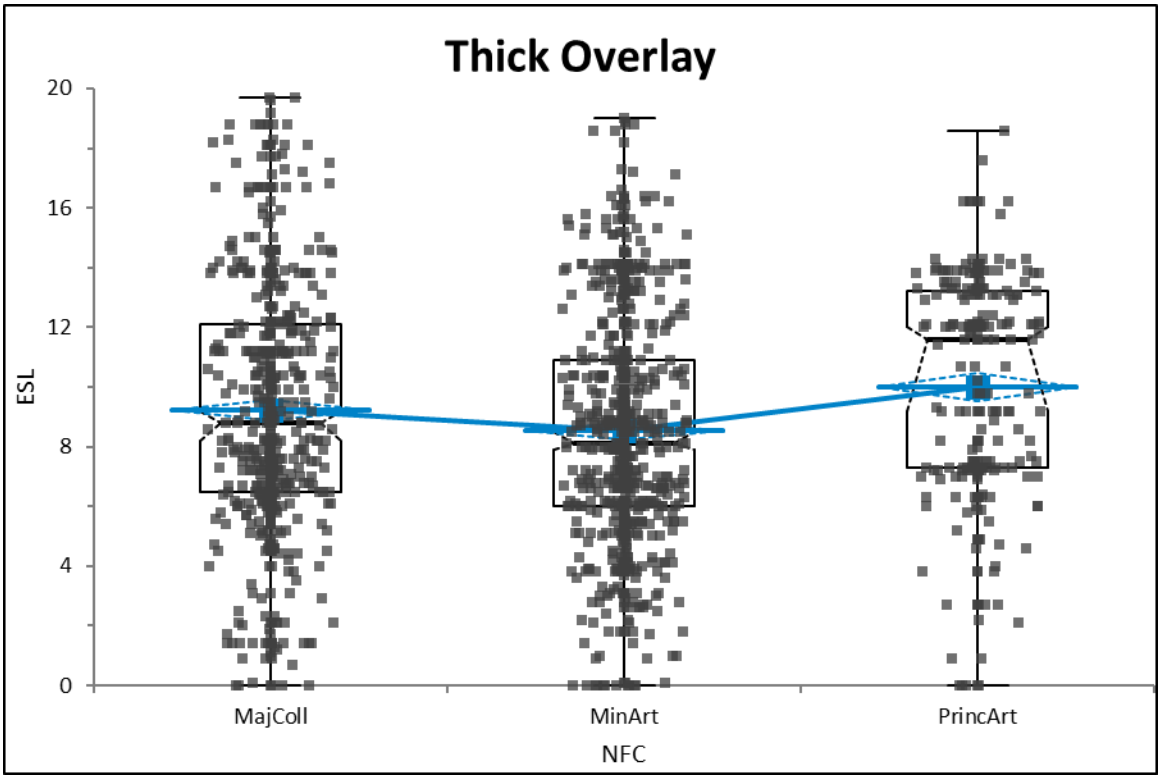

Figure 36: Thick overlay segment distribution by National Function Class

5.15.3 By Number of Lanes

Examining the data based on the segment's number of lanes enables analysis of how the ESL differs when lanes differ. Most of the road miles classified as two-lane; too few road miles classified in the other number-of-lane categories to compare treatments by number of lanes. Table 6 summarizes the mileage breakdown by number of lanes and treatment class. The 0.39 miles (0.628 kilometers) marked "N/A" appeared to be mislabeled route(s).

Table 6: Mileage Breakdown by Number of Lanes and Treatment Class

Treatment Classification	1	2	3	4	5	6	N/A
Heavy CPM	0.2	1143.059	25.013	19.139	18.956		
Rehabilitation	0.041	440.465	16.71	9.419	12.301	0.57	0.39
Reconstruction		19.54	2.249	0.363	1.359		
Total	**0.241**	**1603.064**	**43.972**	**28.921**	**32.616**	**0.57**	**0.39**

5.15.4 By Region

Examining the data based on regions aims to allow for analysis by similar traffic patterns, population density, and material and construction costs. The *2009 TAMC Local Agency Assessment of Average Cost Report* grouped areas of Michigan by region: northern region, southern region, population belt, and cities (their own separate region) (Figure 37).[14] Table 7 shows the mileage breakdown by treatment classification.

[14] From *Estimated Typical Costs for Reconstruction, Rehabilitation and Maintenance Treatments on Local Federal Aid Pavements in Michigan*, Colling, de Melo e Silva and McNinch, 2009.

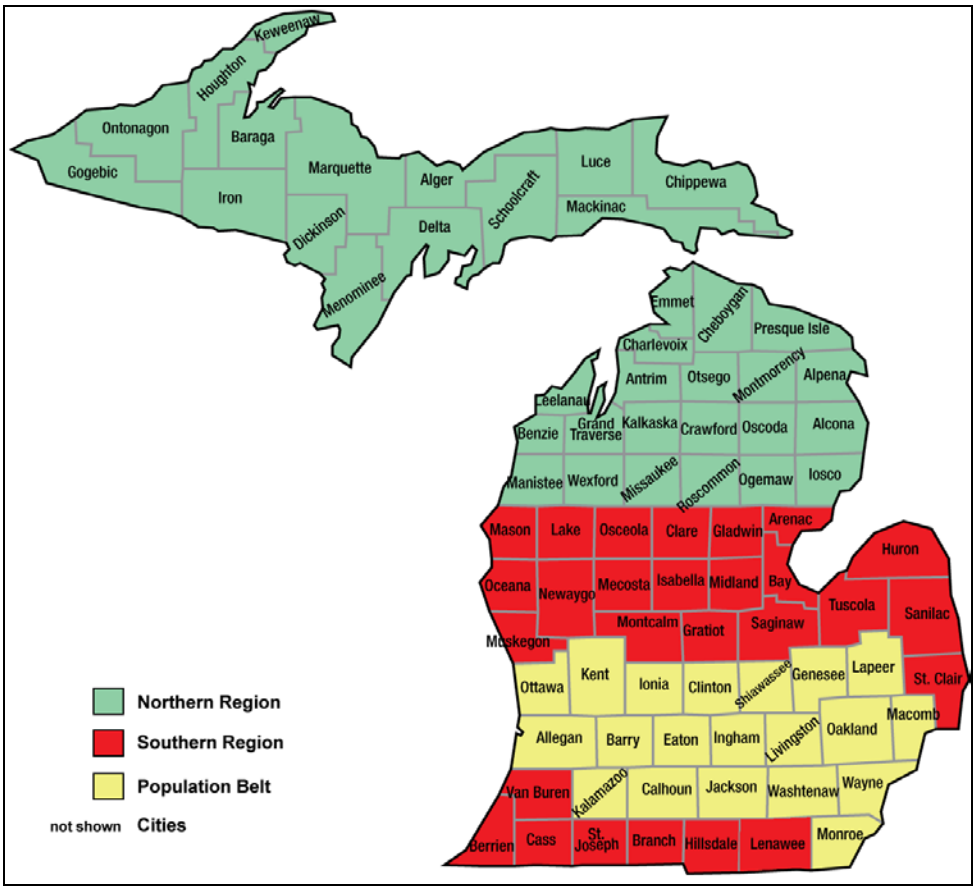

Figure 37: Region Breakdown Map

Table 7: Mileage Breakdown by Region and Treatment Class

Treatment Classification	City	Population Belt	Northern	Southern
Heavy CPM	41.942	133.192	451.857	579.376
Rehabilitation	37.961	66.453	186.573	188.909
Reconstruction	7.748	5.838	9.925	0.000
Total	**87.651**	**205.483**	**648.355**	**768.285**

When broken down by region, chip seal and thick overlay had enough data to show regional differences (Table 8 and Table 9); other repair treatments had too few miles (and segments) to make determinations about regional differences. The population belt and southern regions had enough chip seal and thick overlay miles (and segments) to identify significance (Figure 38 and Figure 39). Both regions' medians show a slight skew compared to the mean for both treatments.

The project team used student *t*-tests to determine whether the ESL results from each of these treatments are statistically discrete from each other. A finding of statistical significance means

the variance in the data is minimal enough to detect the differences in central tendency between groups. These data sets exhibit statistical significance from each other; however, because other variables that influence the ESL (e.g., policies, soil type, annual snowfall) are not controlled by this study, the causality of this statistically significant difference cannot be determined. One variable—thickness of the HMA overlay for the thick overlay treatment—could be controlled; however, there were not enough segments to determine how thickness affects ESL although the general trend was that more ESL was obtained with thicker overlays.

Table 8: Mileage Breakdown of Chip Seal Treatment by Region

Agency Region	Agencies Using	Segment Count	Total Miles	Weighted Avg ESL
City	2	21	2.439	2.7
Northern	4	**173**	**78.687**	**5.3**
Population Belt	**7**	**989**	**290.923**	**4.5**
Southern	**8**	**1189**	**412.809**	**3.7**
Total	**21**	**2372**	**784.858**	

Table 9: Mileage Breakdown of Thick Overlay by Region

Agency Region	Agencies Using	Segment Count	Total Miles	Weighted Avg ESL
City	7	458	37.113	9.6
Northern	3	**148**	**56.403**	**10.3**
Population Belt	**6**	**568**	**99.133**	**9.2**
Southern	**9**	**410**	**109.111**	**8.2**
Total	**25**	**1584**	**301.760**	

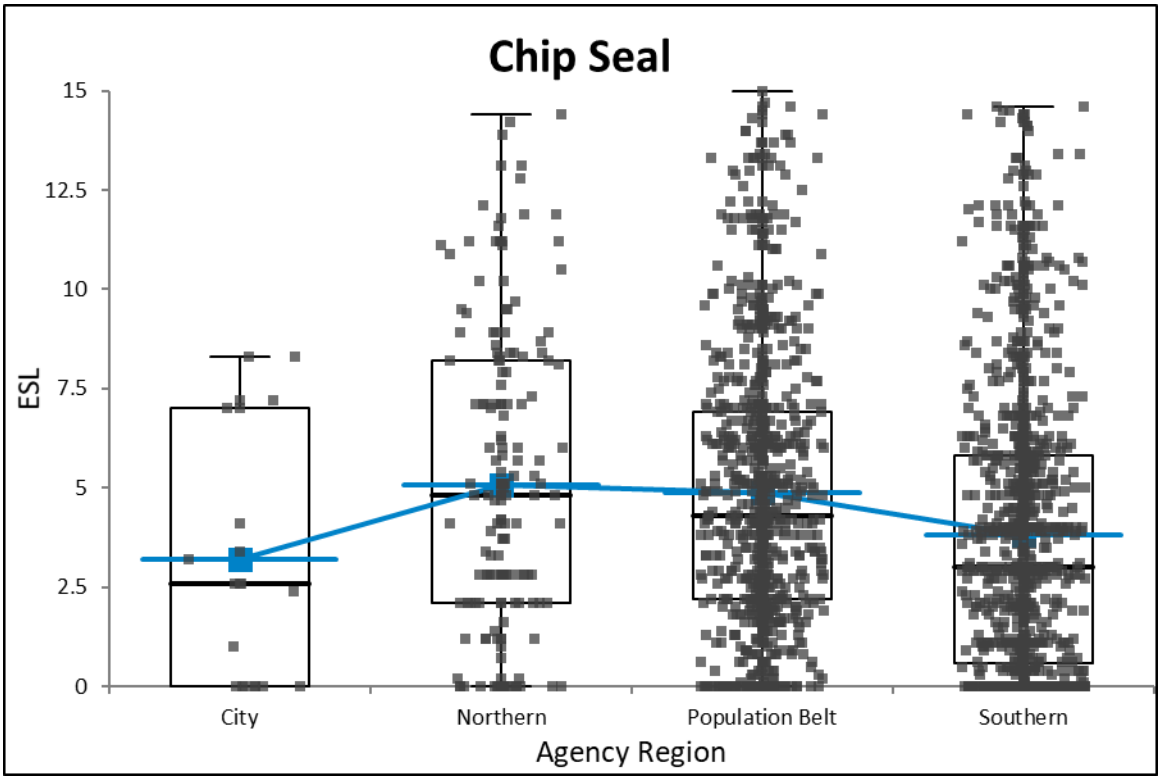

Figure 38: Chip seal non-weighted average ESL segment distribution by region

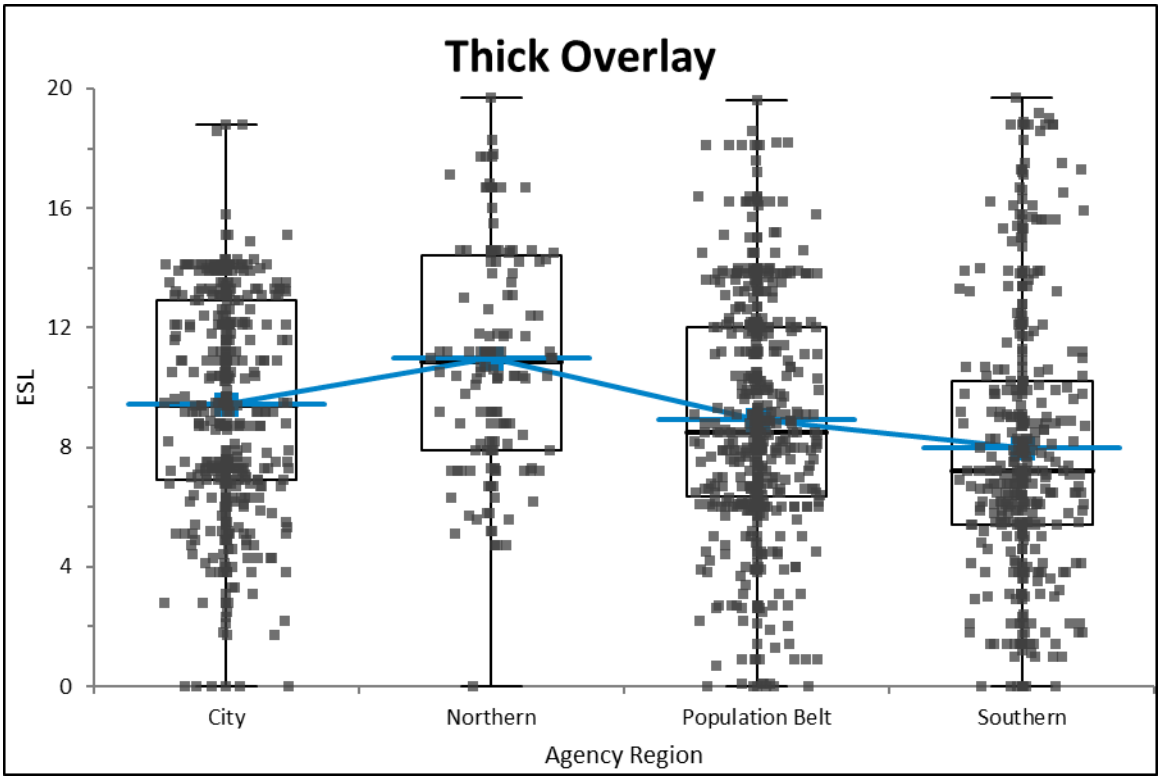

Figure 39: Thick overlay non-weighted average ESL segment distribution by region

5.16 Later-Life Chip Seal Treatments

Local agencies have long used chip seal treatments, which have a shorter service life than other common treatments (such as HMA overlays). This combination of widespread use and a short service life allows for analysis of successively-applied chip seal treatments.

The majority of this analysis looked at segments with no prior treatments. Table 10 shows a breakdown of a unique data set by zero to six prior chip seal treatments. The zero, one, and two prior chip seal treatments categories also had enough miles (and segments) to assess the statistical significance of their central tendency. Eight agencies had segments in each of these three categories (0, 1 and 2 prior treatment). The project team ran the student's *t*-test on these eight agencies' segment distribution; they determined that the central tendency of the data sets are statistically different from each other. The weighted average ESL for segments with one prior treatment decreased to 3.8 years from 4.1 years for segments with no prior treatments. A histogram distribution for segments with zero or one prior chip seal treatment shows a fairly-uniform decrease in frequency of segments achieving longer ESLs (Figure 40 and Figure 41). In contrast, the histogram distribution for segments with two prior chip seal treatments shows a less-uniform decrease in frequency of segments achieving longer ESLs, especially between eight and twelve years of ESL (Figure 42). The weighted average ESL for one prior chip seal treatment (3.8 years) was less than two prior chip seal treatments (4.5 years). This difference is mostly due to the fact that latter has fewer segments that generate low ESLs.

An increase in ESL with successive applications of treatment is unexpected if all things were equal for these two groups, however, it is likely that other factors are present such as more carefully selecting treatment locations.

Table 10: Treatment Breakdown of Prior Chip Seal Treatment(s) by Segment, Miles, and Weighted Average ESL

Prior Chip Seal Treatments	Number of Agencies	Segment Count	Total Miles	Weighted Avg ESL
0	**21**	**2372**	**784.858**	**4.1**
1	**15**	**1045**	**399.986**	**3.8**
2	**9**	**303**	**103.686**	**4.5**
3	5	59	20.599	5.3
4	2	5	2.433	4.9
6	1	1	0.509	3.8
Total	**21**	**3785**	**1312.071**	

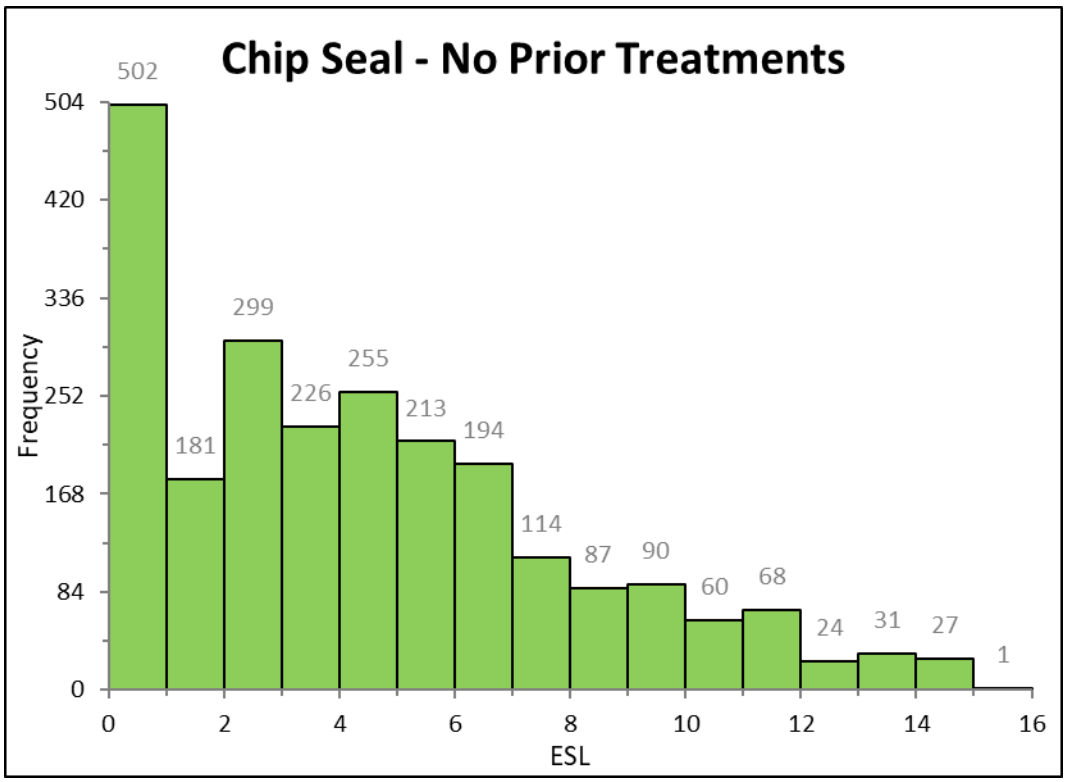

Figure 40: No prior chip seal treatment ESL segment count

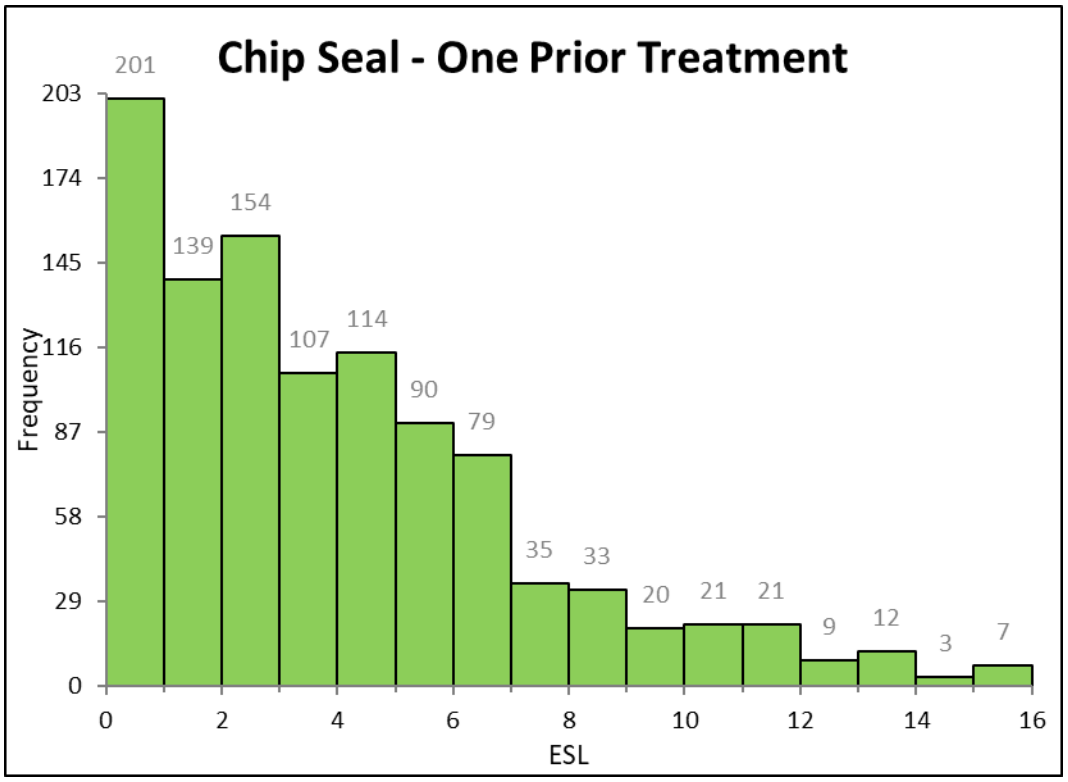

Figure 41: One prior chip seal treatment ESL segment count

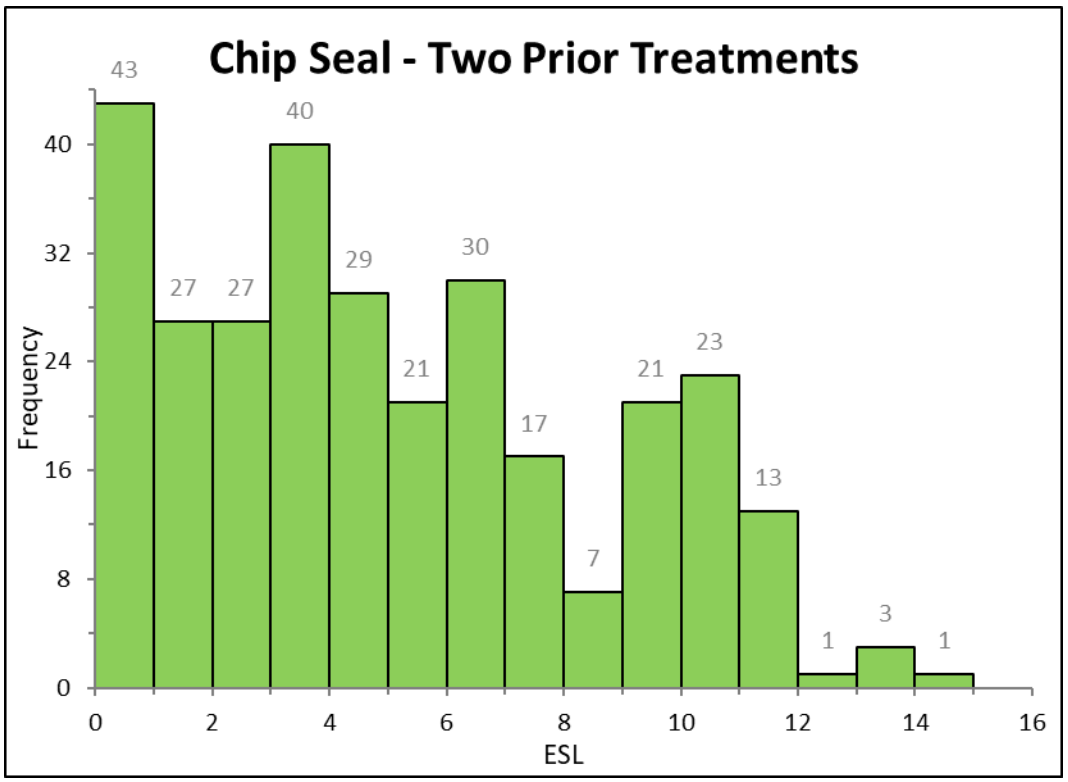

Figure 42: Two prior chip seal treatments ESL segment count

6 DISCUSSION TOPICS

6.1 Conservative Nature of the Study Results

The results from this study should be considered the minimum years of ESL gained by the analyzed treatment. The CTT made every reasonable effort to be conservative in the selection of roadway segments for analysis by using very stringent criteria. Decisions made during the study minimized software-related modeling effects unlike many contemporary studies that rely heavily on modeling repair treatments by aggregate data sets. Individual evaluation of pavement performance models further allowed for an assessment of the reasons for each segment's data fit, which is not possible in aggregate data modeling.

In many instances, the underlying pavement deterioration curves were well-defined by three rating points prior to and three rating points following the CDP (PASER 4 line). This eliminates the effect of modeling on the underlying pavement deterioration curves because the results rely on actual rather that hypothetical data. Similarly, the same practice applied to repair treatment curves, which relied on the presence of a PASER 4 or below score following treatment. The decision to use actual PASER 4—when available—as the ESL measure point also eliminated modeling bias.

Limiting segments with unusually high ESL to a maximum of 15 years ESL for heavy CPM and 20 years ESL for rehabilitation affected 162 heavy CPM segments and 180 rehabilitation segments. The weighted average ESL of these long-life treatments was 26.0 years for heavy CPM and 28.0 years for rehabilitation. Many of these cases were similar to the case shown in Figure 43 where the underlying pavement deterioration curve fit the data well and the repair treatment was clearly performing well according to performance data, however it had a large span of years between the last rating point and the CDP. In this case, it is clear that the repair treatment provided a benefit although the project team believes that additional data points in future years may drastically change the anticipated CDP projection of the model. Limiting the 162 heavy CPM segments to 15 years ESL and the 180 rehabilitation segments to 20 years ESL reduced the statewide weighted average by 0.89 and 1.31 years, respectively. A Minnesota study suggest that 12 or 15 years of ESL is possible for chip seals on properly selected projects, which was the basis for selecting 15 years as the maximum ESL[15]. Rehabilitated pavements would not be expected to last longer than 20 years for a statewide observation.

[15] From: *Rebirth of Chip Sealing in Minnesota*, Wood, Thomas J., Olson, Roger C., 1989: Transportation Research Board.

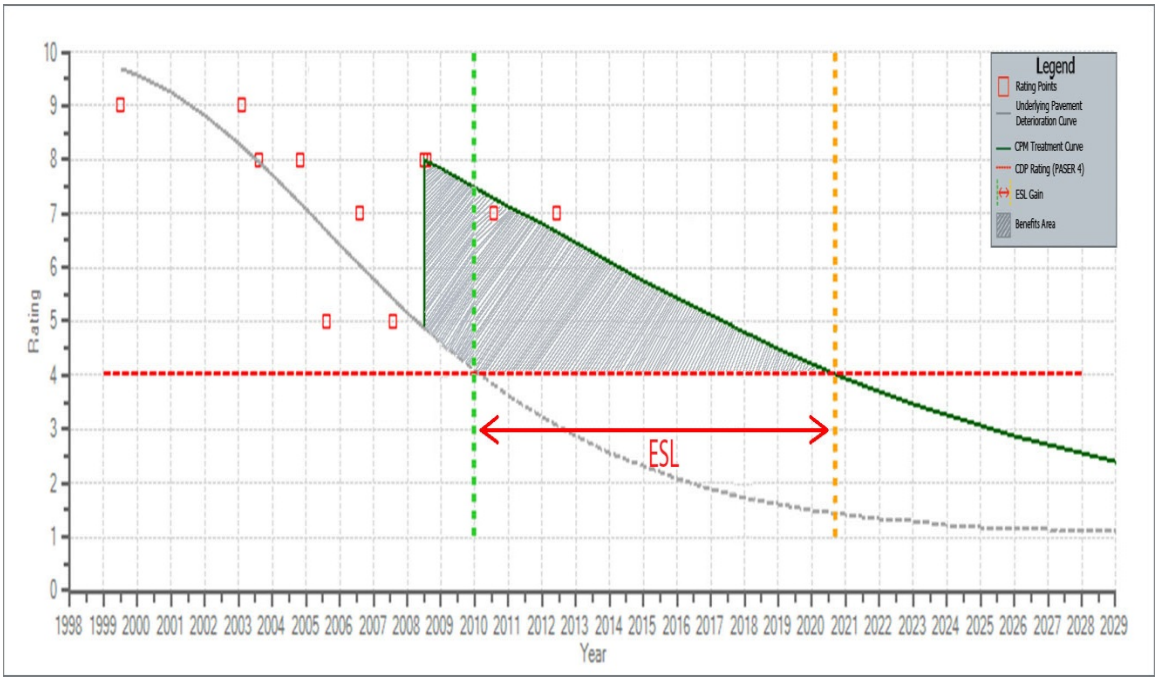

Figure 43: Example of High ESL

6.1.1 Factors Impacting the Effectiveness of Repair Treatments

The effectiveness of any repair treatment depends upon many factors, most of which are difficult to isolate and are highly variable when comparing multiple projects. In general, however, these factors include materials, construction methods, time of application, environmental conditions, and traffic volume. Each of these factors has many sub-variables. For example, the life of a chip seal can be impacted by construction-related variables, such as[16]:

- Cleanliness of the underlying pavement
- Sweeping and removal of excess stone cover chips
- Number of roller passes used before emulsion breaks
- Temperature of the pavement when the chip seal is applied
- Volume of excess chips placed; excessive aggregate or float
- Weather conditions, moisture, high humidity, temperature
- Proximity of asphalt distributor, chip spreader, and roller
- Equipment calibration.

Construction of the underlying asphalt pavement structure can differ greatly from agency to agency and even between segments of roads within an agency. Repair treatments rely on the underlying pavement structure as some treatments, such as CPM treatments, themselves provide little or no structural benefit. If pavement deterioration is driven by structural distresses, then CPM repair treatments will likely provide little or no ESL although other

[16] From *Minnesota Seat Coat Handbook,* Minnesota Department of Transportation, 2006. Available at: http://www.lrrb.org/media/reports/200634.pdf

benefits may result. Pavements that have sufficient structure but are deteriorating due to age-related distresses provide the best base for realizing ESL gains when using CPM treatments. All of these variables result in large variances in ESL gain from project to project.

6.1.2 Low to Zero ESL Gain

The study identified approximately 142 miles (229 kilometers) of treated segments that did not produce a benefit in terms of ESL gain. After application of treatments, condition ratings initially jumped but quickly returned to the underlying pavement's deterioration pattern, thus producing no change in the pavement's predicted intersection with the CDP. Figure 44 illustrates an example of this type of behavior. Repair treatments and even structural improvements that provide no ESL have been observed by many other researchers. Weh-Hou Kuo outlined this behavior for structural overlays in Pavement Performance Models for Pavement Management Systems (MDOT unpublished report, 1995). Low-life extensions after a repair treatment can result from several factors related to either the underlying pavement or the treatment itself.

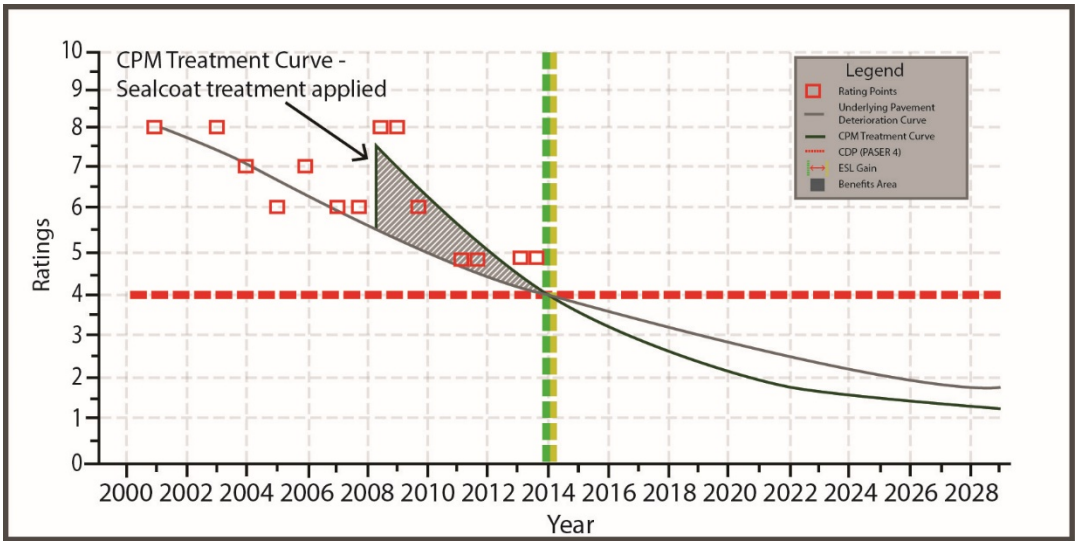

Figure 44: Example of Zero ESL Gain

Repair treatments that are poorly placed with low-quality materials may fail early and constitute a portion of these low or zero ESL cases. Pavements that are deteriorating because of load-related distresses likely comprise a number of these zero ESL cases since repair treatments cannot fix or slow down structural distresses. It is beyond the scope of this study to identify the causes of low or zero ESL cases.

7 CONCLUSIONS AND RECOMMENDATIONS

Data from this study indicated that local agencies were receiving an additional 3 years of ESL by applying fog seal in combination with a chip seal. Chip seal, chip seal plus fog seal, thin overlay, crush and shape, and thick overlay had enough data to deem the ESL findings as significant (Table 11). Also, an ESL decrease of 0.3 years occurs when a chip seal treatment is applied to a pavement with one existing chip seal treatment.

Table 11: Significant ESL Findings

Treatment	Weighted Avg ESL
Heavy CPM	
Chip seal	**4.1**
Chip seal plus fog seal	**7.1**
Thin overlay	**6.9**
Rehabilitation	
Crush and shape	**11.3**
Thick overlay	**9.1**

This study determined that Michigan local agencies are using a wide number of preventive maintenance treatments, and are obtaining ESL gain similar to that of other states.

The seven agencies whose data was not used for this study had submitted a significant amount of data and, after review, it was obvious that they were using asset management principles in their repair treatments. However, these agencies did not have road segments meeting this particular study's rigorous selection criteria.

7.1 Recommendations for Further Research

This study showed that high-quality ESL analyses are possible with the data collected by local agencies on a routine basis. This study also suggests that local agencies have the tools necessary to complete these analyses. The project team therefore recommends the following:

1. The TAMC should consider repeating this study in four to six years when more high-quality data will be available; this will yield a larger data set to analyze.
2. Future research should build upon these findings in order to determine why low or zero ESL gains exist.
3. The TAMC should continue to support and encourage local agencies to collect and evaluate data using pavement management systems, such as Roadsoft, in order to make high-quality ESL analyses easily accomplishable.
4. The TAMC should support agencies in their routine assessment of ESL treatments that they use.

Analysis of TAMC Investment Reporting Data for Network Level Modeling on the Locally Owned Road System in Michigan

Michigan Transportation Asset Management Council

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October 25, 2018

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ABSTRACT

The Michigan Transportation Asset Management Council (TAMC) has been collecting data on pavement maintenance and construction activities via the Investment Reporting Tool (IRT) for several years now. IRT data provides a rich set of infrastructure investment data that can be used for modeling and strategy analysis efforts both on a state and local level. This study evaluates IRT data from 2017 and 2016 for use in modeling efforts.

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EXECUTIVE SUMMARY

Michigan Public Act 499 established the Transportation Asset Management Council (TAMC) to collect, analyze, and report on Michigan's public road network. To accomplish this mission, TAMC has worked with state and local agencies to develop tools, systems, and processes that help roadway owners collect and use roadway asset information. The Investment Reporting Tool (IRT) is of these systems that captures road and bridge construction and maintenance activity from Michigan's 656 local road owning agencies and MDOT.

Road agencies are required to report road and bridge planned and completed construction and maintenance activity annually using the IRT. The IRT data is the most complete source of data for state level condition modeling of Michigan's public roads and bridges. This report analyzes the IRT data collected during 2017 and 2016, and makes recommendations for use of this data at state and local levels for project planning and condition modeling.

The project evaluated data in the IRT data to produce average cost per lane mile figures for four classes of treatments: reconstruction, rehabilitation, heavy preventive maintenance and light preventive maintenance for large cities, counties and small cities. The IRT data was also used to develop estimates of the total quantity of these four treatment classes on local agency roads. The data analysis suggests that IRT data is resilient to common errors in reporting, and produces consistent data that can be used for state and local level modeling and planning.

This study compared reconstruction and rehabilitation projects reported in the IRT, against the against actual bid costs for the reported projects. This analysis indicates that there may need to be clarification on the basis of cost reporting as it relates to preliminary engineering, construction engineering and right of way purchase costs. Overall the impact of these costs appear to be relatively small, effecting primarily the cost of reconstruction and rehabilitation projects. However, more clearly defining the basis of cost with guidance and education would eliminate a source of variability in the IRT data.

1 INTRODUCTION

The Michigan Transportation Asset Management Council (TAMC) was appointed by the State Transportation Commission on September 26, 2002 as required in Public Act (PA) 499. Their mission as defined by this act is to report the condition of the Michigan public road network to the Michigan Legislature [1]. The TAMC's mission is taken directly from PA 499 and states:

> "In order to provide a coordinated, unified effort by the various roadway agencies within the state, the transportation asset management council is hereby created within the state transportation commission and is charged with advising the commission on a statewide asset management strategy and the processes and necessary tools needed to implement such a strategy beginning with the federal-aid eligible highway system, and once completed, continuing on with the county road and municipal systems, in a cost-effective and efficient manner."

The TAMC outlined many tasks necessary to meet the mission of PA 499 and developed these tools, systems, and processes to complete reporting and analysis tasks:

- Investment Reporting Tool (IRT) is the procedure and system developed by the TAMC to meet reporting requirements of Act 499 of 2002 and subsequent amendments. IRT is a statewide road and bridge reporting tool offering a web-based data entry or online reporting from the widely used Roadsoft Asset Management software.
- Act 51 Distribution and Reporting System (ADARS) receives data from the IRT. Local road agencies also report the disposition of funds appropriated, apportioned, or allocated to them under Act 51 on an annual basis using ADARS.
- Pavement Condition Forecasting System (PCFS) receives data from IRT, ADARS, and other sources to help forecast and understand regional and statewide road condition trends.

These systems and tools help local agencies meet reporting requirements while providing road owners, managers, engineers, policy makers, and the public with valuable information on road condition.

Investment reporting data from the Michigan Department of Transportation (MDOT) for state-owned roads were not included in this study because MDOT already has processes in place to report, analyze, and model pavement project data for state-owned roads. Data for state-owned roads are provided as a modeling input for TAMC's pavement model for the state trunk line system under a separate analysis process that is internal to the MDOT.

The IRT study was developed to create modeling inputs for the PCFS system from data reported to TAMC by Michigan's local agencies as part of their annual PA 51 project and financial

reporting. Outputs from this study will also provide data that can be used by local agencies in their own modelling or planning efforts. This study provides the following outputs:

1) A subdivided table of average treatment costs per lane mile that can be used for planning the cost of future projects or modeling the state and local road networks;
2) A subdivided project volume for each treatment class that is extrapolated to account for incomplete reporting and can then be used as model input for TAMC's network-level model;
3) Recommendations for the implementation of processes that will routinely produce these results from the raw data in future years.

2 BACKGROUND

Michigan's public road network is owned by 656 local government units (cities, counties and villages) and the State of Michigan, however, a group that is commonly referred to as the "Big 124" owns approximately 92% of the road network. The Big 124 is comprised of Michigan's 83 county road commissions, its 40 largest cities, and the Michigan Department of Transportation (MDOT). The remaining 8% of Michigan's public roads are owned by 533 smaller cities and villages. Most transportation initiatives focus on the Big 124 because this group's behavior can greatly influence transportation sector outcomes for the whole state.

An important part of the asset management process is forecasting asset condition so that maintenance and construction can be planned well into the future and "what if" scenarios can be contemplated. Asset managers typically use condition modeling which helps improve condition forecasts to guide maintenance and construction strategies, rather than relying purely on professional judgement or historic trends. Pavement condition modeling is important on the state level, and is a critical process to fulfill the TAMC's mission to advise the state legislature on the current and future condition of Michigan's transportation assets.

The TAMC has been using network-level models to predict pavement condition on Michigan's public roads for over a decade. The current pavement condition forecast model is called the Pavement Condition Forecast System (PCFS), which was developed by the MDOT. The PCFS is a network-level model that converts broad state-level budgets into discrete categories of maintenance and construction work. The model estimates pavement condition given a planned course of maintenance and construction activity and anticipated annual deterioration rates.

The TAMC has defined four classifications of construction and maintenance work which are the basis for reporting by road owning agencies. These classifications as defined by the TAMC are as follows:

Reconstruction is the removal and replacement of the majority of the structure of a pavement. This includes additions to the base or sub-base of the road. Examples of reconstruction would be crush and shape with the addition of base materials, or the construction of a new road. In concrete pavements, reconstruction includes rubblizing or crushing existing concrete pavement surfaces for use as added base material followed by the construction of a new concrete surfaces.

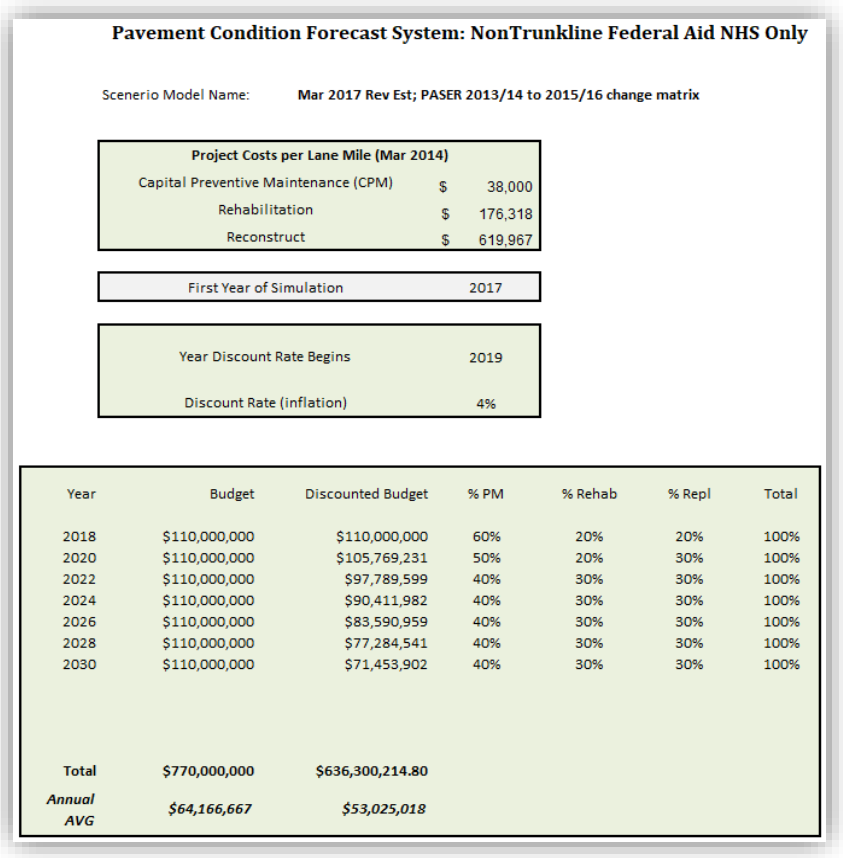
Rehabilitation is the salvage of the majority of the structure of the pavement, either by adding additional structural components (>1.5-inch overlay) to replace failing ones, or by recycling structural components (crush and shape, warm in-place recycling) for the majority of the pavement. Generally speaking, rehabilitation does not include the addition or replacement of base or subbase material other than recycling of failed layers. In concrete pavements, rehabilitation includes extensive full-depth patching and limited full-slab replacement or overlay with hot mix asphalt (HMA).

Heavy Capital Preventive Maintenance (CPM) are bituminous surface treatments such as slurry seal, chip seal, or thin (<1.5 inch) overlays designed to protect the pavement from water intrusion or environmental weathering without adding significant structural strength. In concrete pavements, patching or repair that is less than 1/3 of the depth of the pavement (partial depth repair) are included in this treatment.

Light CPM are treatments primarily designed to seal isolated areas of the pavement from water (crack and joint sealing), or protect and restore surface oxidation with limited surface thickness materials (fog seal). Generally speaking, light CPM will not provide a corresponding increase in PASER rating when applied.

The PCFS can model three of the four TAMC construction and maintenance classifications: Reconstruction, rehabilitation, and heavy preventive maintenance (shortened to preventive maintenance in PCFS). These three construction and maintenance classifications directly impact road condition ratings when they are applied, resulting in an increase in condition rating. The fourth construction and maintenance classification defined by the TAMC is light preventive maintenance, which is not modeled by the PCFS since these treatments do not directly increase the condition of a pavement as measured by the Pavement Surface Evaluation Rating (PASER) condition system. Light preventive maintenance does provide a material benefit when it is applied to pavements, however this benefit is not readily apparent in the relatively course PASER 10 to 1 rating system.

The main user input page for the PCFS system is illustrated in Figure 1 below.



Pavement Condition Forecast System: NonTrunkline Federal Aid NHS Only

Scenerio Model Name: **Mar 2017 Rev Est; PASER 2013/14 to 2015/16 change matrix**

Project Costs per Lane Mile (Mar 2014)		
Capital Preventive Maintenance (CPM)	$	38,000
Rehabilitation	$	176,318
Reconstruct	$	619,967

First Year of Simulation	2017
Year Discount Rate Begins	2019
Discount Rate (inflation)	4%

Year	Budget	Discounted Budget	% PM	% Rehab	% Repl	Total
2018	$110,000,000	$110,000,000	60%	20%	20%	100%
2020	$110,000,000	$105,769,231	50%	20%	30%	100%
2022	$110,000,000	$97,789,599	40%	30%	30%	100%
2024	$110,000,000	$90,411,982	40%	30%	30%	100%
2026	$110,000,000	$83,590,959	40%	30%	30%	100%
2028	$110,000,000	$77,284,541	40%	30%	30%	100%
2030	$110,000,000	$71,453,902	40%	30%	30%	100%
Total	**$770,000,000**	**$636,300,214.80**				
Annual AVG	***$64,166,667***	***$53,025,018***				

Figure 1: User input page for the TAMC's Pavement Condition Forecasting System (PCFS) illustrating the construction and maintenance cost and budget inputs present in the model. Data Sources

3 DATA SOURCES

3.1 Investment Reporting Tool (IRT)

Michigan Public Act 199 of 2007 requires "The department, each county road commission, and each city and village of this state shall annually submit a report to the transportation asset management council… (which) shall be reported consistent with categories established by the transportation asset management council." This act requires the reporting of all maintenance and construction activity completed during the year, and requires the reporting of planned maintenance and construction projects for the upcoming three-year window for the entire public road system. The act also requires the reporting of pavement condition data on the federal aid eligible road system, and bridge asset condition data for the entire public road system.

The TAMC developed a web-based system called the Investment Reporting Tool (IRT) to manage the process of reporting planned and completed maintenance and construction activity for roads and bridges. The IRT collects the location, type, and status of individual road and bridge projects as a direct export from the Roadsoft Asset Management system, or manually using a web interface. This versatility is intended to meet the business processes of various sized local agencies while minimizing duplicated effort. The MDOT also provides data to TAMC on state trunkline road and bridge projects through and export of their data management system to the IRT database.

The IRT allows local agency users to enter data on the following fields: a unique project identifier, the date the project was open to traffic, the location of the project, and the classification of the project. Construction cost data can be linked to IRT data through a unique project identifier that connects construction and maintenance costs from the Act 51 Distribution and Reporting System (ADARS) to a respective project in the IRT (see section 3.2 for more information on ADARS reporting). Data from the IRT and ADARS are linked by the unique project identifier.

Reporting project information using the IRT is mandatory for road-owning agencies, and recently the TAMC made a concerted effort to gain compliance. Local agencies are required to check a "reporting complete" box in the IRT after completing data entry or indicating that there were no planned or completed projects.

The IRT includes user access controls to determine whether agencies have logged on to the system and whether they have finished the reporting process by marking their reporting as complete. TAMC monitors use of the IRT and works to improve compliance with agencies that do not complete the process or who have made obvious errors in reporting. Reporting compliance is high, however some of the 656 road-owning agencies do not fully complete the reporting process each year.

Any construction or maintenance project that is complete and open to traffic during the road agency's fiscal year must be reported in the IRT. The reporting deadlines for the IRT follow the individual road agency's own fiscal year definition. The typical fiscal year reporting cycles used by Michigan road owning agencies are October 1, 2016 to September 30, 2017, January 1, 2016 to December 31, 2017, and July 1, 2016 to June 30, 2017. Each of these reporting periods is considered part of the TAMC 2017 IRT reporting set. Agencies have 180 days after the end of their fiscal year to report investments, which means that 2017 was the most current and fully complete IRT data set when this report was written in mid-2018.

The 2017 and 2016 IRT reporting cycles have a higher reporting rate, which positively reflect the efforts to increase reporting. The IRT data sets were received from the Michigan Center for Shared Solutions (CSS) multiple times during this project as local agencies reported data, and reporting compliance was reviewed. Early versions of the IRT database were used for testing and analytical set up. The final production version of the IRT database used for this study was received on August 16, 2018. The database contains 10,685 projects from the 2017 and 2016 reporting cycles, of which 10,190 are local agency projects and 495 are MDOT projects.

Data was filtered from the production version of the IRT/ADARS data set to remove MDOT projects, yielding a database containing 5025 local agency projects for 2017, and 5165 local agency project from 2016. To remove likely erroneous entries, analysts discarded projects that were missing data or had project costs less than ten dollars.

In the fiscal year 2017 IRT reporting cycle, 51 of the 656 Michigan local agencies did not fully complete the required IRT reporting, or were under review at the time of analysis, and in 2016 only 45 local agencies did not complete reporting. See Section 5.4 for more detail on incomplete reporting. Project data from local agencies that did not complete reporting, or that were still under review were removed from the analysis in this study because it could not be determined if those reports were complete. Methods for estimating the volume of this missing data are discussed later in this report.

CTT staff manually reviewed the filtered local agency data set to remove bridge, culvert replacement, and gravel road projects. The resulting filtered database is expected to only contain projects on paved roads that were intended to improve pavement condition, and submitted by local agencies that had fully completed the IRT/ADARS reporting process.

Figure 2 below illustrates the process flow used to filter raw IRT/ADARS data and arrive at the final database. Appendix A includes a similar figure for the 2016 data set. In 2017 approximately 9% of the total local agency project dollar value was removed as a result of filtering. Approximately 1.7% of the 2016 local agency project dollar value was removed as a result of these filtering processes. The higher removal percentage in 2017 was several local agency submittals were still being reviewed by the TAMC staff at the time data was received, and as such does not indicate reporting compliance issues.

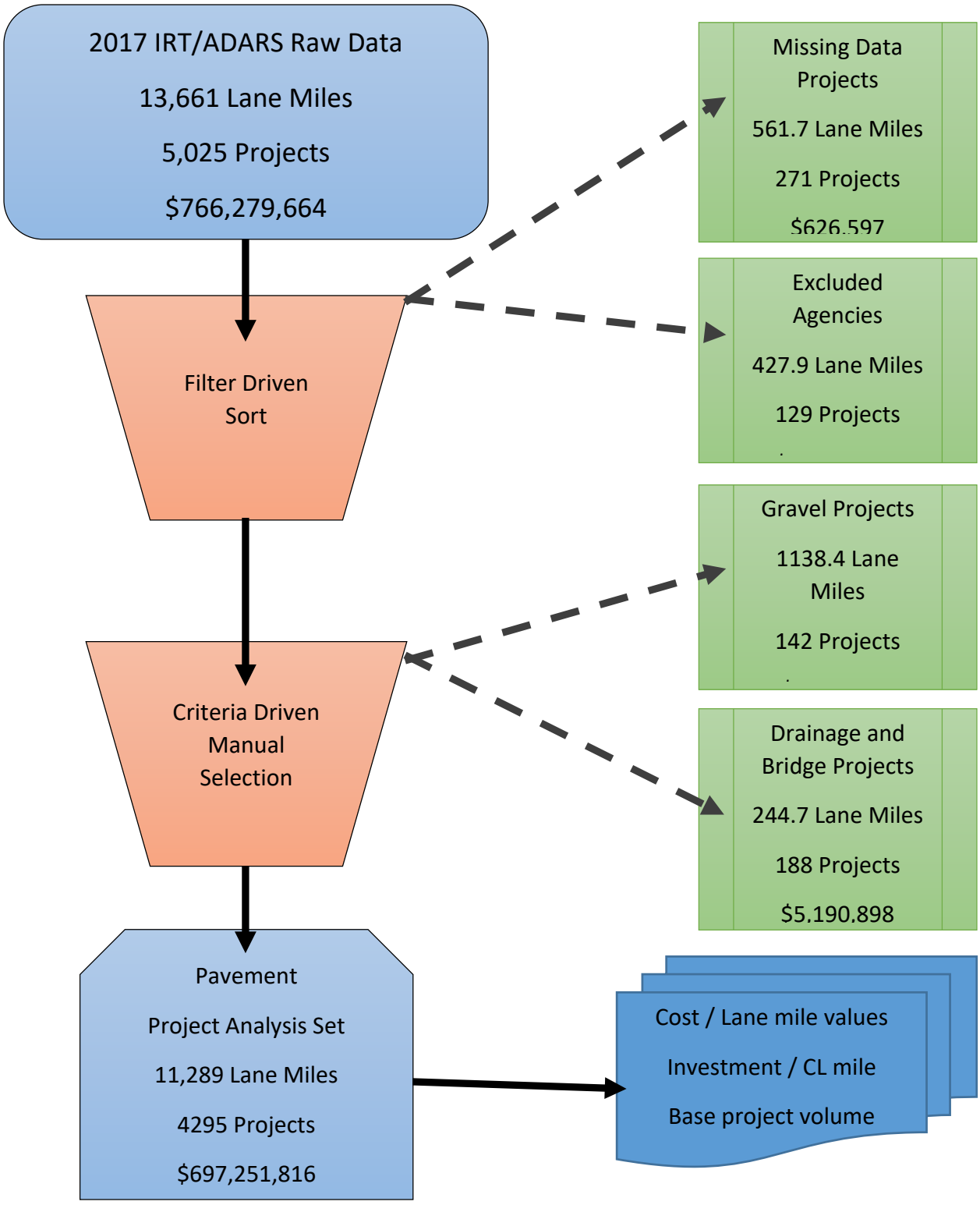


Figure 2: 2017 IRT/ADARS processing to develop analysis data set

3.2 Act 51 Distribution and Reporting System (ADARS)

Michigan local agencies are required to report their annual financial information relating to transportation spending to the Michigan Department of Transportation (MDOT). The MDOT developed the Act 51 Distribution and Reporting System (ADARS), which is a web based tool that streamlines the reporting of financial information. The ADARS system provides a link between the details of the road and bridge construction projects reported in the IRT to financial information for those individual projects. IRT and ADARS project and finance information are linked via a user entered project ID which allows joining of the information in the two databases. ADARS reporting cycles are matched with the IRT reporting cycle. See section 3.1 for details in the IRT.

ADARS data was provided by the Michigan Center for Shared Services (CSS) as a joined data set so that financial data from ADARS was linked to the respective IRT project using the unique project identifier in both data sets. CSS manages both the IRT and ADARS systems.

3.3 Michigan Department of Transportation Bid Letting System

All road construction projects in Michigan on state owned roads, and locally owned road project that use federal dollars must be processed through the MDOT bid letting system. This system processes over a billion dollars in construction and maintenance projects each year between roads owned by MDOT and local agencies. At least once per month bid openings are schedule and the resultant bid tabulations are processed through the MDOT letting system.

The MDOT bid letting systems provides very detailed information on individual projects that are put out for bid for contractor consideration. Data includes: a short description of the project detailing the work type and approximate limits, a listing of the types of pay items associated with the project, the quantity of each of the pay items, and the prices contractors bid for the respective items. The letting systems also include the total prices for each contractor that has bid for the project and an engineer's estimate of costs.

The MDOT bid letting system provides the most extensive single set of bid data for transportation construction projects in the state of Michigan. The system provides a narrative description of the work in each bid project. The bid letting systems only provides basic detail on the extent of the project with respect to the lane miles of pavement treated. Each project includes the details on the mile point of beginning and ending, however there is no data field that provides a square unit of measurement for the number of lane miles of treatment completed or the specific construction and maintenance classification of the project, however, this information can be determined from other data in the system.

Data from local agency owned projects from May 2016 to October 2017 bid lettings were analyzed to determine bid costs for local agency let projects. A total of 1,078 projects were let

during this time period in the MDOT bid letting system, which included the 238 local agency owned projects that were open to traffic in 2017.

The area of extent for each project in the bid letting system was determined by locating the project via google maps from the bid description. The width of located projects were determined by finding the number of lanes via Google Street View. The number of lanes estimated from a project was multiplied by the length of the project described in the bid description to develop an estimate of lane miles of activity for each project.

Let projects were classified into the TAMC's four construction and maintenance types based on the project description and pay items present in the bid.

Interpretation on area of extent and project classification are likely to provide a source of error since it is subject to interpretation by people not familiar with the project. This error is likely to overestimate the extent of the project work since project limits outlined in the bid system are typically the maximum extent of all the work on the project and may not actually reflect the extent of pavement work.

Project data from the MDOT's bid letting system were compared both individually and in aggregate to ADARDS and IRT reporting data as an indicator of the cost capture of ADARS reporting.

4 METHODS

4.1 Evaluation of Missing Data Due to Non-Complete Reporting

TAMC has worked with the Michigan Center for Shared Services (CSS) to develop performance metrics to measure compliance with reporting requirements which can also be helpful to estimate the impact of unreported projects from non-responsive agencies. CSS regularly reports the number of local agencies who have not logged in to the IRT system before the reporting deadline, the number of local agencies who have not marked "reporting complete" in the IRT. Both of these cases may result in unreported projects. The TAMC staff review submittals from local agencies to determine if they have met reporting requirements and looking for obvious errors after a submittal has been made.

In 2017 IRT/ADARS data set there were 51 local agencies that either did not fully complete reporting process or still had pending reviews of their submittals. In the 2016 IRT/ADARS data set this number of local agencies was 45. These local agencies are not necessarily out of compliance with reporting requirements, nor does this mean that the agencies did not report projects using the IRT. However, for the purposes of this study these agencies were excluded from the analysis to mitigate any concerns over data quality or completeness.

A summary of the 2017 and 2016 agencies that were excluded from this analysis and the centerline mileage of their respective road networks are listed in Table 1 below.

Table 1: Local agencies that were excluded from this study due to incomplete reporting or pending data review during the 2017 and 2016 IRT/ADARS reporting cycles.

2017 Excluded Agencies by Agency Type	Number of Agencies	Total Centerline Miles	Fed Aid Centerline Miles	Non Fed Aid Centerline Miles
County	8	9214	2540	6674
Top 40 Cities	2	412	119	293
Small Cities and Villages	41	537	100	436
Total	51	10162	2759	7403

2016 Excluded Agencies by Agency Type	Number of Agencies	Total Centerline Miles	Fed Aid Centerline Miles	Non Fed Aid Centerline Miles
County	0	0	0	0
Top 40 Cities	1	155	45	110
Small Cities and Villages	44	829	170	658
Total	45	984	215	769

Projects reported from local agencies excluded from this study constitute 8% by total project dollars in 2017, and 1.6% of the total project dollars reported in 2016. While this percentage is small, it is still worthwhile to estimate the loss of project volume for agencies who did not fully report to remove this as a source of error in modeling or reporting efforts.

Local road owing agencies that were responsive in reporting IRT–ADARSA data can be used as a proxy for agencies that were excluded from this study. The use of peer proxies allows IRT-ADARS data to be expanded to account for missing data in total project expenditures and total lane miles of road projects completed. Two methods for assigning peer proxies are discussed in this section. Method 1 will be demonstrated in section 5.0 of this report.

4.1.1 Method 1: State Average Agency Spending

This method subdivides local agencies in to three groups; Counties, Top 40 Cities, and Small Cities and Villages. These subdivisions are based on the relative proportion of road ownership in Michigan and have a significance in transportation spending. Average project investments per agency owned centerline mile of road were calculated for each of the three local agency groups from investment data that was reported in the IRT. Local agencies that did not complete reporting in the IRT were removed from the calculation of average project investment per centerline mile. The investment rate (average project investment per centerline mile) can be multiplied by the centerline road network size from agencies that did not complete reporting to make an estimate the total missing investments in each of the four TAMC project classifications.

Table 2 below summarizes average annual dollars of project investments per centerline mile as reported in the 2017 IRT-ADARD database.

Table 2: Average annual spending per centerline mile according to 2017 IRT/ADARS reporting.

TAMC	County		Top 40 City		Small City or Village	
Treatment Class	Federal Aid	Non Fed Aid	Federal Aid	Non Fed Aid	Federal Aid	Non Fed Aid
Light CPM	$ 231	$ 32	$ 865	$ 84	$ 348	$ 77
Heavy CPM	$ 2,439	$ 527	$ 4,263	$ 1,149	$ 3,288	$ 847
Rehabilitation	$ 6,208	$ 897	$ 26,303	$ 4,334	$ 8,652	$ 2,618
Reconstruction	$ 2,940	$ 381	$ 15,288	$ 8,474	$ 11,518	$ 4,059

A similar trend is apparent when analyzing 2016. Table 3 illustrates investment spending per centerline mile analysis from 2016 IRT/ADARS reports.

Table 3: Average annual spending per centerline mile according to 2016 IRT/ADARS reporting

TAMC	County		Top 40 City		Small City or Village	
Treatment Class	Federal Aid	Non Fed Aid	Federal Aid	Non Fed Aid	Federal Aid	Non Fed Aid
Light CPM	$ 81	$ 14	$ 977	$ 104	$ 372	$ 95
Heavy CPM	$ 2,569	$ 418	$ 5,574	$ 1,648	$ 2,997	$ 1,035
Rehabilitation	$ 6,443	$ 861	$ 18,828	$ 4,874	$ 11,581	$ 1,969
Reconstruction	$ 5,407	$ 577	$ 12,318	$ 5,657	$ 14,205	$ 2,926

This method produces reasonable estimates of unreported project activity by using all agencies in a given year as a proxy for agencies that were excluded from the study. It is specifically usefully when not much is known about the history or level of activity of the excluded agency. Average spending per year should be aggregated over several years as a longer history of these spending trends becomes available. Multiyear averaging minimizes yearly variance in

Reconstruction investments that may be swayed by a few high cost projects on an annual basis. Multiyear averaging is a best practice, but will not significantly impact investment calculations on a state level if it is not completed in the next few years.

4.1.2 Method 2: Planned Projects

IRT reporting data can be estimated for agencies that did not report in a given year or were excluded from the study, but have been responsive in the past. Historic reporting of planned projects provides a reasonable estimate of missing investment data. Previously reported planned projects provide an estimate of the work that likely occurred in a year that no data was reported or where there are concerns over data quality. This method should be used in cases where data is available before considering the use of state average investments from Method 1. The drawback from this method is that most agencies that are unresponsive in a given year, may be more likely not to have provided accurate planned project information in past years. As the TAMC continues to collect and use planned project data this method will become more viable and will likely be the preferred method.

4.2 Basis of Project Cost

Determining the basis of project costs is an important step in any financial reporting and modeling where budgets are used as the basis for determining the lane mile extent of a future work program. The basis of cost for projects used in a modeling or planning effort should always be the same as the budget being modeled to avoid over or under estimation of the value of a given funding level.

The basis of costs determines what is considered included and excluded on when reporting a project cost or a budget. A basis of cost can be all inclusive “agency total cost” by adding non-construction costs for a project such as the cost of right of way purchase, construction and design engineering, construction testing and surveying along with the costs of the physical construction activity.

Costs outside of physical construction costs are more likely to be a significant factor with reconstruction and rehabilitation projects due to their complexity, and are not likely to be as significant on light and heavy capital preventive maintenance projects, which usually do not require significant engineering, testing or surveying services.

The document titled “Instructions for Preparing the Act 51 Street Report for Cities and Villages on the ADARS” provides guidance for the basis of costs of construction and maintenance project reporting. This same guidance is echoed in the ADARS training and the fact sheet “Investment Reporting 101, Key Points on IRT/ADARS – 4/4/2016”. This guidance says:

> “Enter all expenditures for street construction on Major and Local Streets. This category should include expenditures that can be directly assigned to a construction project, (i.e.,

engineering fees, ROW acquisition, etc.). Include charges for payroll, related fringe benefits, equipment rentals, materials, and contractual services that were charged to a project."

This guidance appears to be all inclusive of expenses for road and bridge projects, however, it unclear if these costs specifically include only construction phase services, or if pre-construction costs such as preliminary design engineering included.

One county finance officers that spoke to the research team indicated that they believed that this guidance may be interpreted differently among local agencies. The finance officer believed that this provision limits reporting of costs to only the current year that a construction project is completed. This understanding of this guidance would exclude design services, and may have a significant impact on the reporting of multiple year construction projects, since only the costs in the final year would be reported.

Correspondence and phone calls with MDOT's Bureau of Transportation Planning indicates that data for IRT/ ADARS reports for MDOT's road projects include construction phase costs only.

"MDOT only reports on the Construction Costs (This does not include costs associated with Early Preliminary Engineering, Preliminary Engineering, Environmental Clearance, Permitting or Real Estate purchases). It does include Construction Engineering so we are confirming it includes testing, surveying, equipment and materials."

At a minimum it appears that the basis of cost being reported by the MDOT and the local agencies differs in how right of way costs are included or excluded in IRT/ADARS reporting. There also appears to be anecdotal evidence that the open nature of the cost guidance may be interpreted broadly by local agencies. Neither of these items are catastrophic in nature, but are sources of "noise" in the cost per lane mile data.

4.2.1 Impact of Design and Construction Services on Project Costs

Design and construction services are a significant percentage of the total cost of transportation projects. Typically, these costs are expressed as "preliminary engineering" or PE, and "construction engineering" or CE.

Preliminary Engineering is commonly defined as:

"[P]lanning and design of a highway project first receives funding authorization for planning and/or design activities. The delivery of the construction documents used for solicitation of construction contract bids (known as project letting) marks the end of PE." (Hollar, 2011)

Construction engineering or CE includes professional services necessary for the contractor to construct the job. This can include surveying, field engineering, inspection and testing by the project owner.

PE and CE are most often these costs are expressed as a percentage of the physical cost to construct the transportation project. A literature review of states that have published data on

design and construction cost contributions to total project cost indicate that the project size, complexity and work type all contribute to the relative expense of design and construction services necessary to deliver a project.

In 2002 Washington Department of Transportation (WashDOT) completed a national survey of PE and CE costs on specific road construction projects which included bridge and road components (Highway Construction Cost Comparision Survey, 2002). This survey remains one of the most cited pieces on the topic of PE and CE costs. Analysis of the data from 24 state departments of transportation that responded to the WashDOT survey indicated PE costs typically averaged about 10.3% of physical construction costs and CE averaged 11% of construction costs. The MDOT response to this survey indicated that PE was 8% of physical construction costs and CE ranges from 0 to 15% of physical construction costs.

CE and PE costs conservatively add between 21 to 27 percent of the physical construction cost for DOT projects that are of a similar size typical local agency reconstruction and rehabilitation projects. In Michigan on the federal aid eligible road system it is reasonable to expect that these PE and CE percentage would be similar for local agency owned reconstruction and Rehabilitation projects.

5 RESULTS

5.1 IRT/ADARS Project Cost Results

Raw data from the 2017 IRT/ADARS submittals were processed to isolate local-agency road projects by removing any bridge projects and removing any projects on state-owned roads. The local-agency road data set was then filtered to remove projects from local agencies that had not fully completed the report process, or whose data was still under review by the TAMC. See section 4.1 for details. Projects which did not contain cost data were also removed from the analysis set.

The data from the analysis set was subdivided into the four TAMC treatment classifications and separated based on road system category. The total dollars of projects in each of these subdivided categories were divided by the total lane miles of projects in that respective category to produce a weighted average cost per lane mile for each specific class of projects. This technique of weighting projects by the number of lane miles assigns more significance for bigger projects rather than assuming all projects are of equal value. Weighting by lane miles makes it less likely that data errors or small, high cost projects will influence the calculated cost per lane mile figures.

The percentage on a dollar basis was calculated for each of the specific treatment classifications. The summarized IRT/ADARS average cost per lane mile data at the statewide level for 2017 are presented in Table 4. This table provides inputs for the PCFS model.

Table 4: Statewide IRT/ADARS project cost data for 2017.

All Projects Statewide					
	# of Projects	Lane Miles	Total Dollars	% of Total	Dollars/LM
Light CPM	837	2,264.2	$ 10,840,529	1.55%	$ 4,788
Heavy CPM	1,756	5,547.3	$ 115,921,824	16.63%	$ 20,897
Rehabilitation	1,218	2,766.2	$ 321,777,460	46.15%	$ 116,326
Reconstruction	484	711.5	$ 248,712,003	35.67%	$ 349,545
Totals	***4,295***	***11,289.1***	***$ 697,251,816***		
Federal Aid Projects Statewide					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	400	1,672.5	$ 7,551,626	2%	$ 4,515
Heavy CPM	572	3,343.0	$ 67,114,433	17%	$ 20,076
Rehabilitation	419	1,600.7	$ 208,974,236	52%	$ 130,552
Reconstruction	168	350.7	$ 120,087,742	30%	$ 342,451
Totals	***1,559***	***6,966.9***	***$ 403,728,036***	100%	
Non Federal Aid Projects Statewide					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	437	591.6	$ 3,288,903	1%	$ 5,559
Heavy CPM	1,184	2,204.2	$ 48,807,391	17%	$ 22,143
Rehabilitation	799	1,165.5	$ 112,803,224	38%	$ 96,787
Reconstruction	316	360.9	$ 128,624,260	44%	$ 356,439
Totals	***2,736***	***4,322.2***	***$ 293,523,779***	100%	

The weighted average cost data used for this study contained a number of projects that appeared to be outliers from a cost per lane mile standpoint. Many of these outliers were projects with very short segment lengths, which led to a large cost per lane mile calculation. At least one of these outliers appears to be a representation of an agency wide crack sealing program that was placed on a single segment of road because the individual locations were not known. The impact of these outlier projects was investigated by performing a sensitivity analysis.

The sensitivity analysis removed projects with a total size of less than 0.2 lane miles, which equates to approximately 528 feet long by two lanes. This length was chosen because it is less than a typical city block. Projects that appear to be in the wrong treatment classification were also removed from the analysis to test the impact of data errors. Comparison of the altered data set used for the sensitivity analysis with the statewide average for light CPM, heavy CPM, rehabilitation, and reconstruction found in Table 4 reduced weighted average cost per lane mile results by 1.91%, 1.07%, 1.80%, and 2.58%, respectively. Changes in results of this magnitude were not considered to be significant considering other sources of variation.

The weighted average cost per lane mile calculations of the four project classifications have been further subdivided by agency type (County, Top 40 City and Small City) and are included in Appendix B. Data tables in Appendix B include data for 2017 and 2016.

Several trends were apparent from the IRT/ADARS project cost per lane mile data. County road commission projects typically had the lowest cost per lane mile, followed by small cities and villages, with the Top 40 Cities having the largest cost per lane mile. Federal aid projects were typically cost more per lane mile than non-federal aid eligible projects with the exception of light CPM in all city categories, and reconstruction for the top 40 cities. Figure 3 below graphically illustrates the calculated cost per lane mile data from 2017.

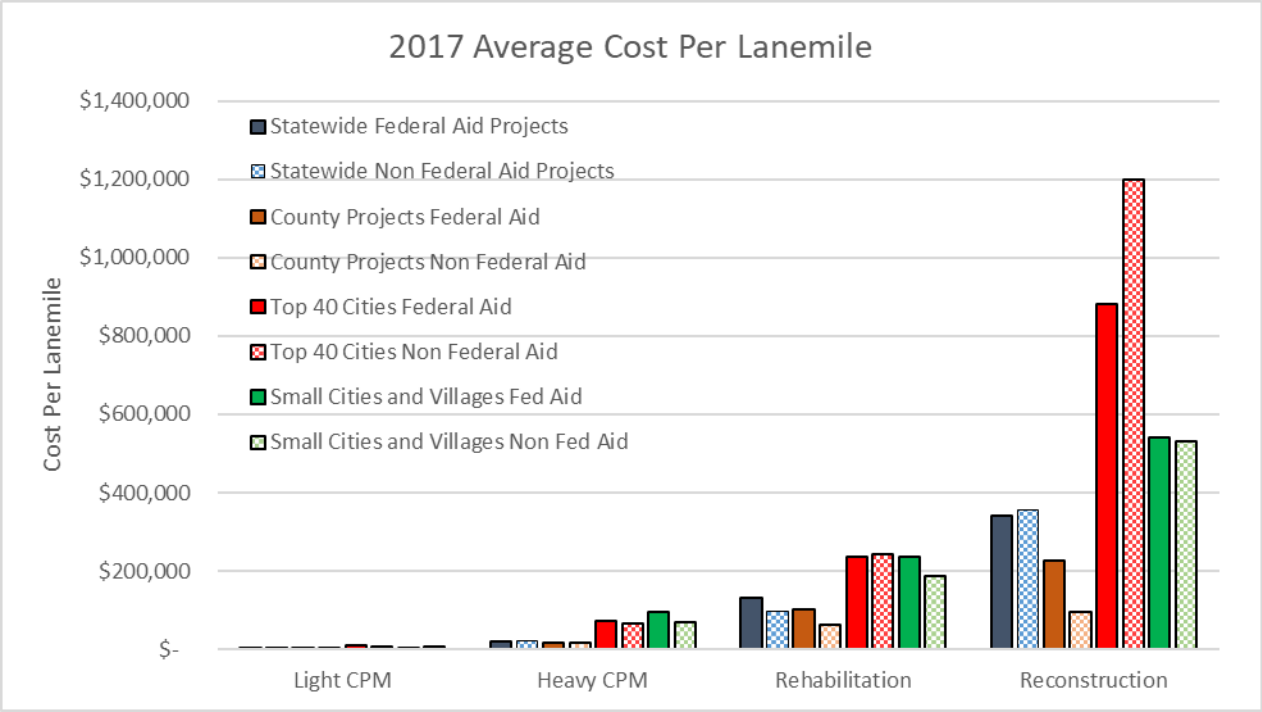


Figure 3: 2017 Weighted average project cost per lane mile data from IRT/ADARS system

Figure 4 below illustrates the total lane miles of local agency projects in the 2017 IRT data set after filtering described in Section 3.1. As previously discussed, this data is a subset of all the reported data which represents about 92% of the 2017 IRT/ADARS local agency submittal. This figure illustrates the relative impact that county road commissions activities have on the overall local agency own system due to their high volume of project work. Data from 2016 exhibits a similar pattern.

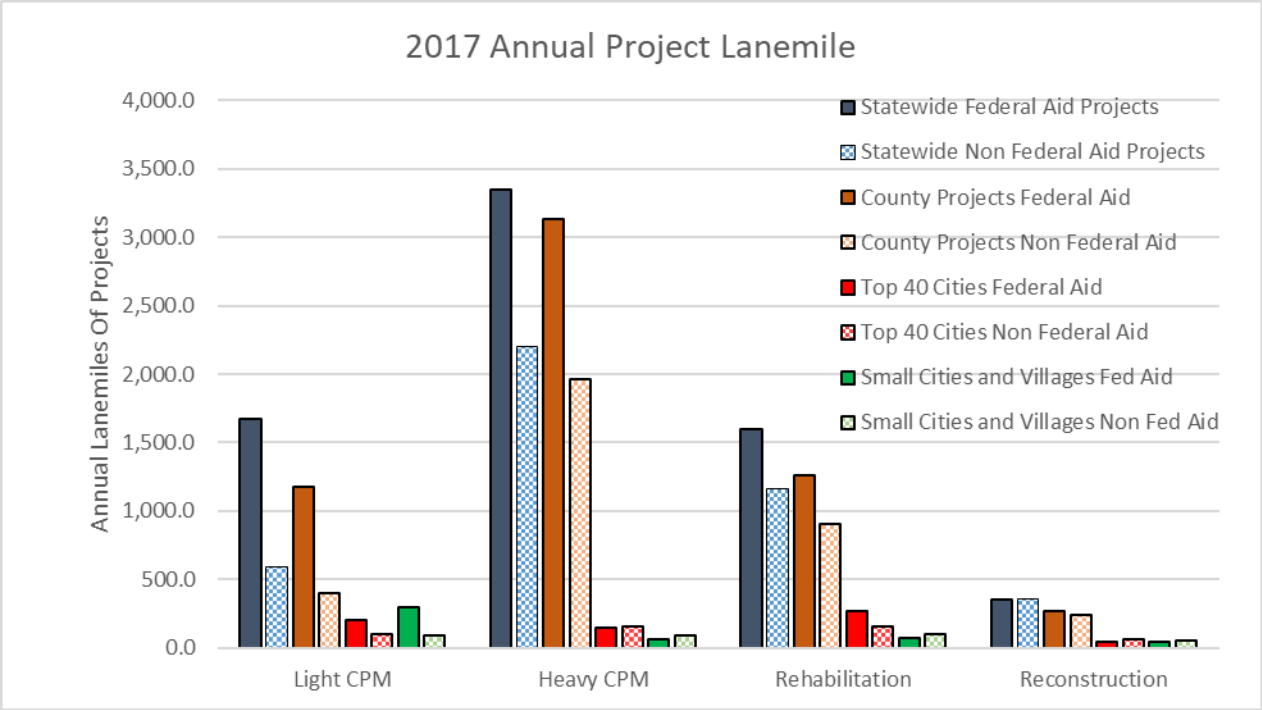


Figure 4: 2017 Total lane miles of road projects in the analysis set separated by agency type from IRT/ADARS reporting

Figure 5 below illustrates the total dollars in the analysis set and in each project classification respective of local agency type after filtering described in Section 3.1. County road commission spending in rehabilitation and light and heavy preventive maintenance represent the majority of the dollars in these categories. However, reconstruction dollars for counties and the top 40 cities are almost identical in total volume.

The project cost per lane mile and total volume differential between cities and counties are both significant for state level modeling efforts. Reconstruction and rehabilitation in cities are a small portion of the total miles of road work completed every year, however, they constitute a very significant total dollar volume.

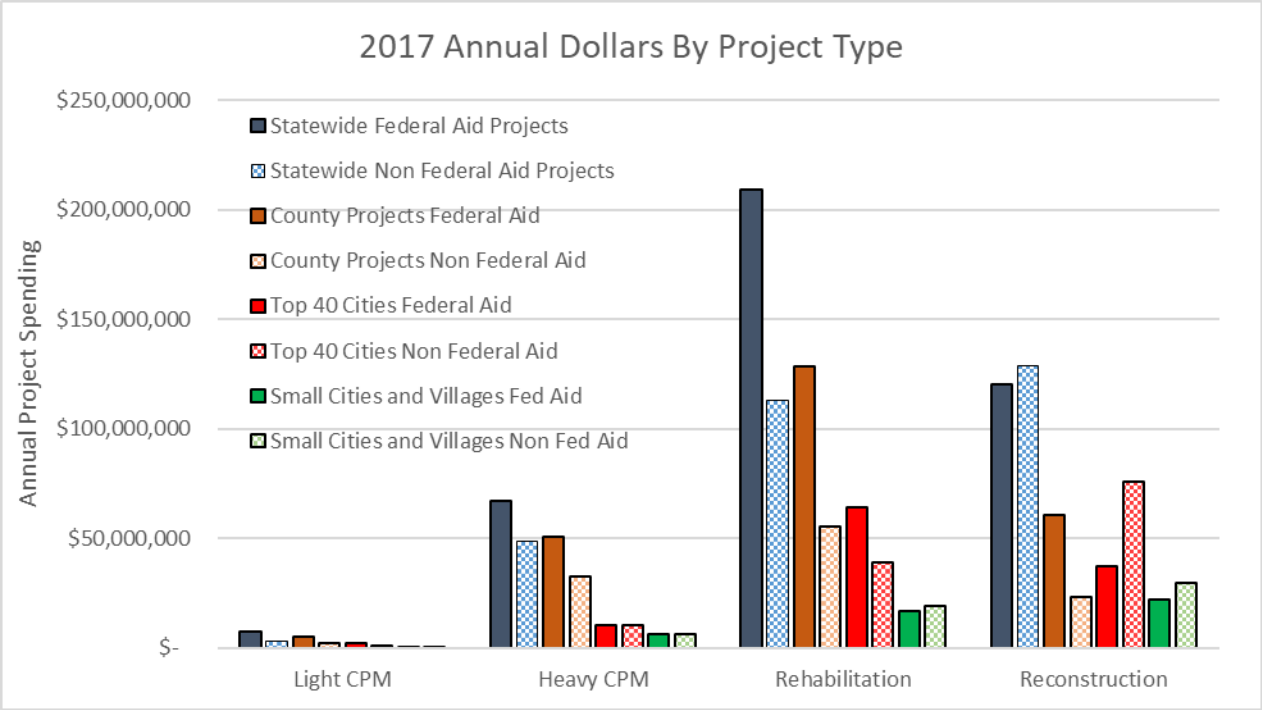


Figure 5: 2017 Total dollars of projects by agency type contained in the analysis set from IRT/ADARS Reporting

Data shown in Figure 3, Figure 4, and Figure 5 for 2016 IRT/ADARS reporting are included in Appendix B.

5.1.1 Analysis of IRT/ ADARS Data for Common Treatments

The IRT-ADARS data set was analyzed using the common treatment name to break down the four treatment classifications into their component treatment types. Projects with similar common treatment names were aggregated and compared as a group. Projects that did not include a common treatment name or where the intent of the common treatment name was unclear were excluded from the analysis. Groups of common treatment names that did not include over 40 individual projects were aggregated with another similar group when possible.

Table 5 and Figure 6 below illustrate the average weighted cost per lane mile data for common treatments identified in the combined 2017 and 2016 IRT/ADARS data set. The cost per lane mile calculations of the common treatments have been further subdivided agency type (County, Top 40 City and Small City) and are included in Appendix C. Calculations in Appendix C include data for 2017 and 2016.

Table 5: 2017 and 2016 IRT/ADARS average weighted cost per lane mile calculations for common local agency treatments at a state level.

2016 & 2017 Statewide Projects					
TAMC Class	Project Subcategory	# of Projects	Lane Miles	Total Project Dollars	$/LM
Heavy CPM	Chip Seal	1918	7937.2	$ 97,255,143	$ 12,253
Heavy CPM	Slurry or Cape Seal	112	510.1	$ 9,961,373	$ 19,528
Heavy CPM	Micro Surfacing	233	270.7	$ 8,739,353	$ 32,281
Heavy CPM	Ultra Thin Overlay	115	288.1	$ 10,595,521	$ 36,780
Heavy CPM	Mill and Fill - Non Structural	412	437.0	$ 44,946,306	$ 102,855
Heavy CPM	Overlay - Non Structural	652	1133.0	$ 63,980,522	$ 56,468
Rehabilitation	Mill and Fill - Structural	180	284.8	$ 38,887,034	$ 136,538
Rehabilitation	Overlay - Structural	566	1044.3	$ 101,343,033	$ 97,046
Rehabilitation	Crush and Shape	474	940.6	$ 143,728,966	$ 152,804
Rehabilitation	Minor Rehab	142	308.2	$ 20,769,477	$ 67,393
Rehabilitation	Major Rehab	101	373.0	$ 62,881,715	$ 168,567
Rehabilitation	Resurfacing	810	1762.1	$ 242,868,181	$ 137,825
Reconstruction	Reconstruction	766	1126.9	$ 435,638,749	$ 386,598

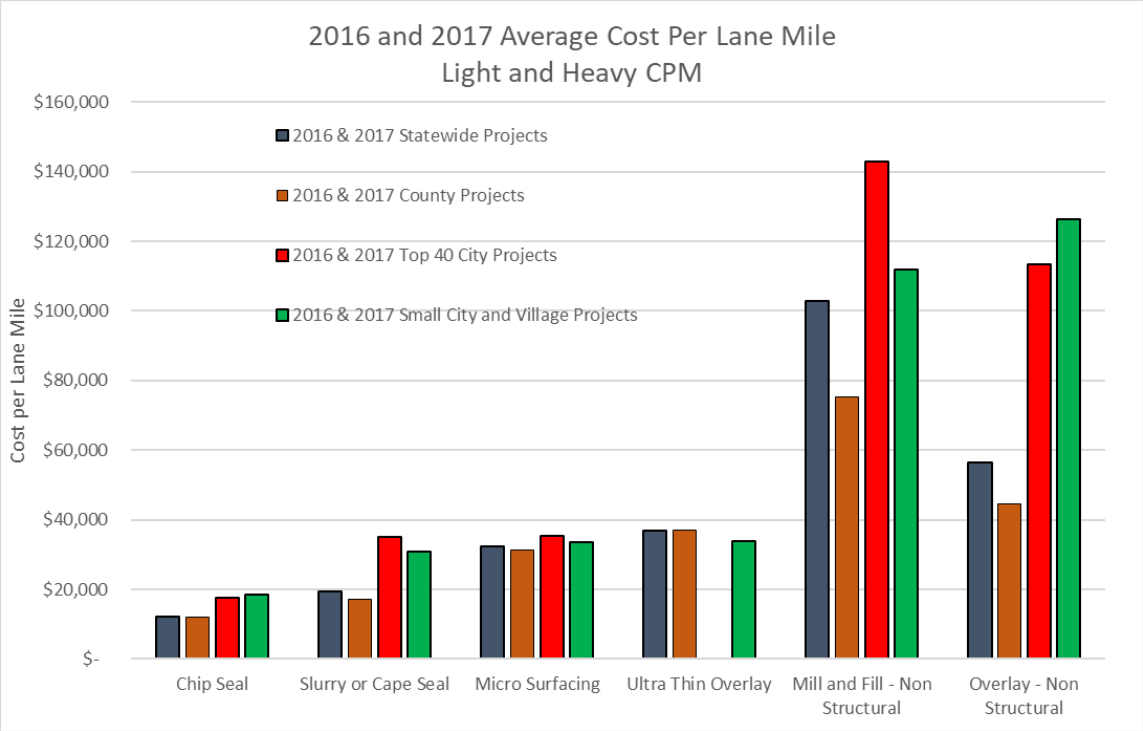


Figure 6: Weighted average cost per lane mile for common preservation treatments

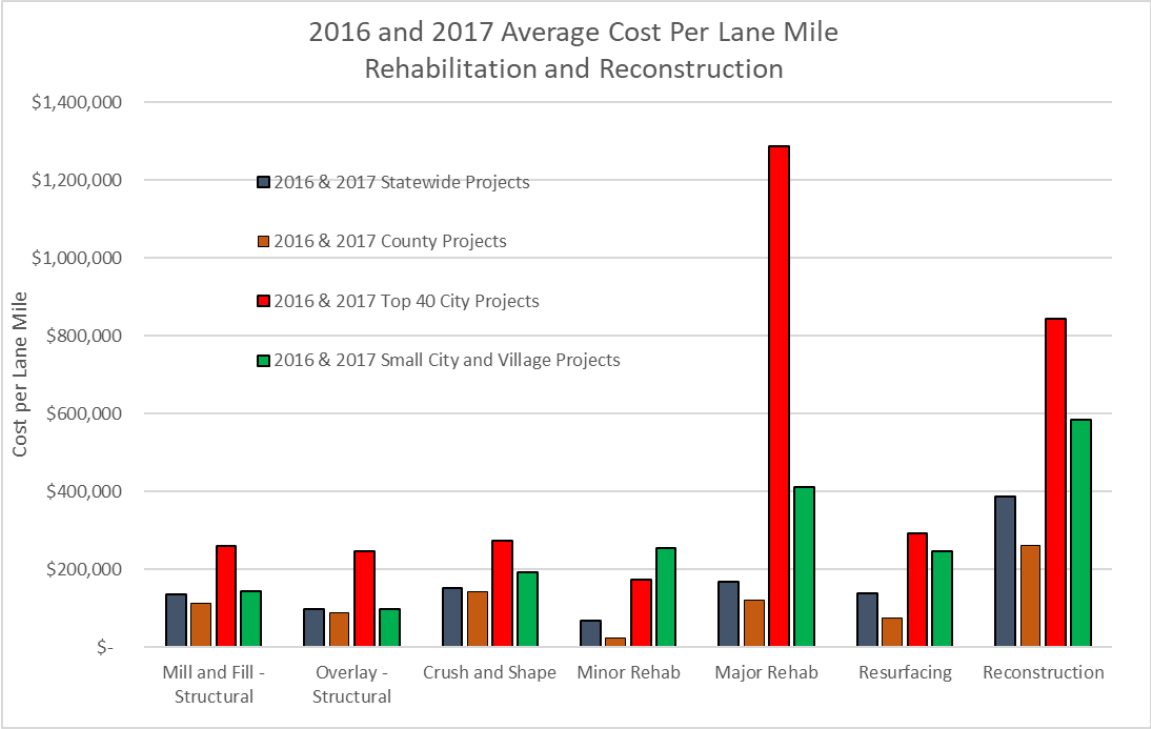


Figure 7: Weighted average cost per lane mile for common structural treatments

5.2 Treatment Volume Results

Analysis of IRT/ADARS reporting compliance from 2017 indicates that a very small number of local agencies did not fully complete reporting of completed projects in the IRT, and only a few of these agencies were still being reviewed by TAMC staff. These local agencies and the data that they submitted were removed from the analysis of this study to avoid any concerns over data quality or completeness.

The local agencies that were responsive to reporting can be used as a proxy for non-responsive agencies by the use of average project investments per centerline mile as previously calculated in Table 2 and Table 3. The excluded agencies and the centerline miles of road that they represent by agency type and project classification are illustrated in Table 1. Multiplying unreported lane miles in Table 1 by the respective investment per centerline mile factors from Table 2 and Table 3 results in an estimate of unreported dollars in each project classification for the respective years. Table 6 illustrates the estimated unreported investments for 2017 as a result of excluding local agencies from this study. This data is the product of Table 2Table 1 and Table 2. This unreported investment is $57 million total dollars, which is 8.2% of the total local agency spending in 2017.

Table 6: Estimate of unreported investments from agencies not completing reporting in 2017.

TAMC	County		Top 40 City		Small City or Village	
Treatment Class	Federal Aid	Non Fed Aid	Federal Aid	Non Fed Aid	Federal Aid	Non Fed Aid
Light CPM	$ 586,931	$ 215,494	$ 102,969	$ 24,514	$ 34,968	$ 33,555
Heavy CPM	$ 6,194,322	$ 3,520,297	$ 507,646	$ 336,328	$ 329,966	$ 369,599
Rehabilitation	$ 15,765,603	$ 5,984,480	$ 3,132,299	$ 1,268,697	$ 868,104	$ 1,142,333
Reconstruction	$ 7,465,396	$ 2,544,172	$ 1,820,615	$ 2,480,701	$ 1,155,760	$ 1,771,034
Total	**$ 30,012,252**	**$ 12,264,442**	**$ 5,563,529**	**$ 4,110,240**	**$ 2,388,797**	**$ 3,316,521**

Unreported investments for 2016 were calculated using this same technique using the product of Table 1 and Table 3, and are illustrated in Table 7 below, with an unreported investment total of $11.9 million.

Table 7: Estimate of unreported investments from agencies not completing reporting in 2016.

TAMC	County		Top 40 City		Small City or Village	
Treatment Class	Federal Aid	Non Fed Aid	Federal Aid	Non Fed Aid	Federal Aid	Non Fed Aid
Light CPM	$ -	$ -	$ 43,744	$ 11,501	$ 63,356	$ 62,783
Heavy CPM	$ -	$ -	$ 249,506	$ 181,776	$ 510,018	$ 681,377
Rehabilitation	$ -	$ -	$ 842,735	$ 537,740	$ 1,971,084	$ 1,296,647
Reconstruction	$ -	$ -	$ 551,353	$ 624,102	$ 2,417,723	$ 1,926,282
Total	**$ -**	**$ -**	**$ 1,687,339**	**$ 1,355,119**	**$ 4,962,181**	**$ 3,967,088**

The unreported local agency spending from Table 6 and Table 7 is added to the results of the IRT/ADARS reported spending to produce a total estimated spending for each of the four treatment categories and the three agency classifications, and are illustrated in Table 8 and Table 9 below. These two tables represent the suggested modeling inputs for the PCFS model.

Table 8: Total estimated local agency spending in 2017 adjusted for agencies that did not fully report IRT/ADARS data

TAMC	County		Top 40 City		Small City or Village	
Treatment Class	Federal Aid	Non Fed Aid	Federal Aid	Non Fed Aid	Federal Aid	Non Fed Aid
Light CPM	$ 5,365,296	$ 2,198,684	$ 2,207,720	$ 774,144	$ 703,478	$ 589,638
Heavy CPM	$ 56,624,000	$ 35,917,636	$ 10,884,206	$ 10,621,264	$ 6,638,160	$ 6,494,715
Rehabilitation	$ 144,117,718	$ 61,059,729	$ 67,158,246	$ 40,065,532	$ 17,464,277	$ 20,073,473
Reconstruction	$ 68,243,244	$ 25,958,222	$ 39,035,009	$ 78,340,718	$ 23,251,260	$ 31,121,229
Total	**$ 274,350,258**	**$ 125,134,271**	**$ 119,285,181**	**$ 129,801,657**	**$ 48,057,176**	**$ 58,279,054**

Table 9: Total estimated local agency spending in 2016 adjusted for agencies that did not fully report IRT/ADARS data.

TAMC	County		Top 40 City		Small City or Village	
Treatment Class	Federal Aid	Non Fed Aid	Federal Aid	Non Fed Aid	Federal Aid	Non Fed Aid
Light CPM	$ 1,879,283	$ 947,122	$ 2,448,788	$ 940,715	$ 769,151	$ 752,266
Heavy CPM	$ 59,631,151	$ 28,481,745	$ 13,967,270	$ 14,868,057	$ 6,191,721	$ 8,164,327
Rehabilitation	$ 149,574,769	$ 58,654,699	$ 47,176,165	$ 43,983,560	$ 23,929,362	$ 15,536,552
Reconstruction	$ 125,519,185	$ 39,280,005	$ 30,864,655	$ 51,047,438	$ 29,351,645	$ 23,080,899
Total	**$ 336,604,387**	**$ 127,363,571**	**$ 94,456,878**	**$ 110,839,770**	**$ 60,241,879**	**$ 47,534,044**

5.3 Evaluation of Local Agency Basis of Cost

Project cost data from the MDOT bid letting system is a resilient source of information on bid costs for federal aid road projects both at the state and local levels. This information can provide a useful comparison to IRT/ADARS cost data.

Information from MDOT's bid letting system provides project cost data that only represents contractor low bid cost for specific projects. The bid letting data does not include construction over or under-runs in the construction phase of the project. Current professional practice in Michigan indicates that low bid costs are routinely within +-10% of the final physical construction costs for most projects. While there may be outliers, +-10% is a typical planning threshold.

Bid letting data from local agency projects from 2016 were collected from MDOT's bid letting system. Projects identified as local agency projects were classified based on the project description into one of the TAMC's four project categories (reconstruction, rehabilitation, heavy preventive maintenance, light preventive maintenance). The total length of the project was estimated using the start and end point locations included in the project description. Google Earth and Google Street view were used to determine the number of pavement lanes within each project boundary to calculate a lane mile number for each project. Summary data from bid analysis is presented below in Table 10 below.

Table 10: Bid letting costs from 2016 lettings for locally owned federal aid eligible projects matched to ADARS projects in 2017.

	# of Projects	Lane Miles	Total Dollars	Dollars/LM	% of Total
Light CPM	1	$ 306.1	$ 622,610	$ 2,034	0.29%
Heavy CPM	22	$ 385.6	$ 12,174,076	$ 31,575	5.71%
Rehabilitation	136	$ 576.5	$ 98,348,397	$ 170,599	46.10%
Reconstruction	73	$ 140.0	$ 102,170,859	$ 729,844	47.90%
Totals	***232***	***1408.2***	***$ 213,315,943***		100%

The cost per lane mile averages for heavy CPM, rehabilitation, and reconstruction generated from bid letting exceed the averages generated for the federal aid network using IRT/ADARS reporting data. See section 5.1 and Appendix A for details on IRT/ADARS costs. This analysis is not a one-to-one comparison of projects, and it is likely that projects present in the MDOT bid letting system are of a more complex subset of the projects that are submitted in the IRT/ADARS system. These more complex projects would likely have a higher cost per lane mile. While this particular analysis is not conclusive, it is a trend that was investigated further with other techniques.

The relationship between IRT/ADARS costs and bid letting data was investigated by finding and comparing individual projects that were bid, constructed, and reported to TAMC through the IRT/ADARS system. Projects in the 2017 IRT data set were matched to their respective 2016 bid letting data. Project matches were identified based on the project's description in the bid letting system and the PR and mile point data from the IRT/ADARS system.

Only 57 reconstruction or rehabilitation projects are present in both the 2016 bid letting data and the 2017 IRT / ADARS data, which was expected since many federal aid project are bid several years before they would be reported in the IRT.

Matched pairs of bid letting data and IRT/ADARS data are presented in Table 11. The trend observed in the aggregate comparison of letting vs ADARS cost was again apparent when comparing the total let cost of these matched pairs of projects with their respective IRT/ADARS costs. The let costs of the matched pairs exceed the reported ADARS project costs for these projects.

Table 11: Bid letting costs and ADARS costs for matched reconstruction and rehabilitation pairs on locally owned, federal aid eligible projects.

Project Type	Number of projects	Total Let Cost	Total ADARS Cost
Reconstruction	21	27,199,199	23,149,232
Rehabilitation	36	25,629,326	24,807,865

The reported IRT/ADARS cost for each of the matched 57 projects were subtracted from the respective let cost to calculate a project by project cost difference. This cost difference was

expressed as a percentage of the let cost for each of the 57 matching projects. Analysis of the magnitude of the difference between let-cost data and IRT-ADARS cost data for matched pairs of projects is illustrated in Figure 8 below.

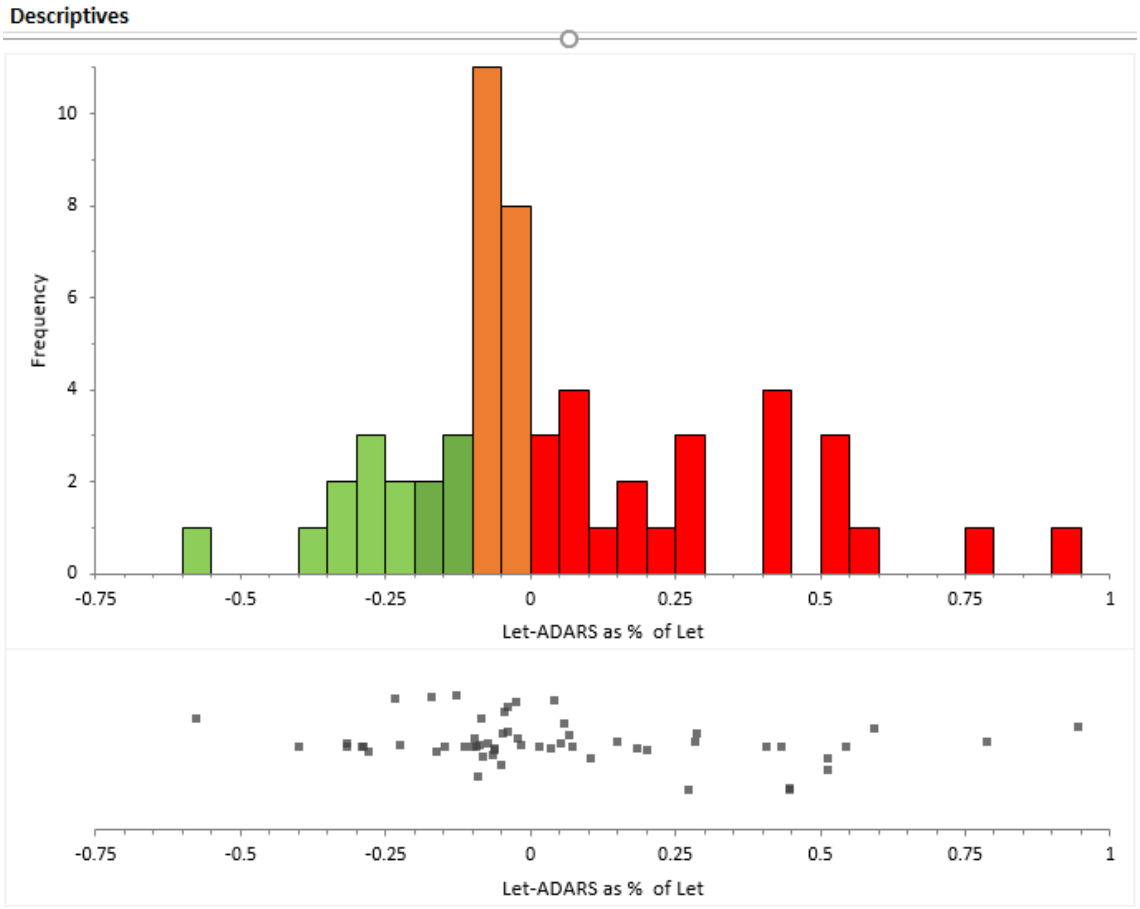


Figure 8: Frequency and box plot chart illustrating the percentage difference between let cost data and IRT/ADARS Cost data for matched pairs of projects.

NOTE: Negative scale means LET data is lower than IRT/ADARS data, positive scale means LET data is higher than IRT/ADARS data. Projects illustrated in green are within the expected range exceeding let costs. Projects illustrated in red are lower than expected IRT/ADARS costs when compared to Let data.

It is surprising to see the large portion of projects that had bid lettings in excess of the reported ADARS costs for the project. Some of these projects may be the result of bid savings, meaning the total quantity of pay items was less than estimated by the bid package, resulting in a lower total cost than the contractors bid. However, this would typically account for at most at 10% bid savings.

Bid letting costs do not include PE and CE costs for normal project delivery, so some or all of those costs should be included in IRT/ADARS reports depending on how cost reporting guidance is interpreted. Conservatively estimating PE may range from 10% to 16% of physical construction costs on reconstruction or rehabilitation projects. CE can account for an additional 11% to 16% on top of physical construction costs.

Interpreting the data shown in Figure 8 requires the creation of a reasonable threshold for comparison of let costs to final project costs considering sources of additive and subtractive expenses. It is feasible that project underruns could account for a savings of 10%, so the lowest reasonably expected physical construction cost could be 10% lower than the let cost. Including PE costs would add 10% or more to the physical construction costs, and CE would add another 11% or more to the physical construction cost. Therefore, let costs should be at least 1% under ADARS cost if only CE is included (ADARS cost = Let cost – 10% bid savings, +11% CE cost) and let cost should be 11% under the ADARS cost (ADARS cost = Let cost – 10% bid savings, +10 PE cost, + 11% CE cost) if both CE and PE are included.

Projects that have IRT/ADARS reported costs lower than their let costs are shown in red in Figure 8. These projects constitute 42% of the matched projects in this study. The criteria developed in the previous paragraph would indicate that these projects are outliers if CE costs were included in IRT/ADARS costs that were reported.

Matched pair projects that are shown in orange in Figure 8 constitute 33% of the total projects. These projects, in addition to the projects shown in red, constitute 75% of the matched pairs, and are considered to be outliers if both CE and PE are included in the IRT/ADARS costs.

At the far end of the spectrum there are 10% of the matched pair project that have IRT/ADARS costs that are less than half the let cost. These projects may be reporting errors that are a misunderstanding of the basis of cost, or they may represent data entry errors.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1.1 Project Cost Per Lane Mile

IRT data provides a wealth of cost information and project volume information that is useful for local agency, regional, and state planning. Compliance with the project reporting requirements are high, with an estimated 92% of the reported data useful for analysis without quality or completeness concerns. This should not be misconstrued as a measure of compliance, but rather a measure of data used by this study for analysis.

Project cost per lane mile data calculated from the IRT/ADARS data set appears to be resilient to the level of errors and inconsistencies observed in the entered data. This was tested by performing a sensitivity analysis on the cost per lane mile data.

Project cost per lane mile data from this study is comparable to the TAMC Treatment Cost Survey that was completed in 2008. The 2008 survey asked local agency staff to provide their planning costs for projects on a lane mile basis but did not evaluate any actual project data, and the definitions for preventive maintenance were slightly different than the current TAMC project classifications.

Data from the statewide project cost tables and project volume table from this report should be used as the basis for modeling local agency road networks. This data represents the best source of cost and treatment volume data available at the state level. The data should be calculated annually and combined in a three year rolling average data set to eliminate year to year changes that may occur due to a few large projects.

6.1.2 Basis of Cost Reporting

Analysis of MDOT bid letting system and IRT-ADARS total project costs for local agency projects indicates that it is likely that CE and PE costs are not being captured by local agency project reporting. This may be due to a misunderstanding of the basis of costs, or it could be due to the specifics of the accounting systems that local agencies use and how they track time and expenses. Work is therefore needed to better define and communicate to local agencies the basis of project cost reporting for ADARS, and specifically whether CE and PE should be included.

MDOT currently excludes right of way costs in their reporting to TAMC, whereas these costs are included in local agency data. These costs may not be significant at the state level, and MDOT likely has the ability to either estimate or directly report these costs. While this may not be a serious concern for the use of the data, the issue underlines the confusion over the basis of costs that are to be reported.

There is no right or wrong answer as far as including or excluding CE and PE costs, since methods exist for estimating their impact to an overall budget. However, agencies should be

instructed to either include or exclude these costs to ensure consistency among agencies and between reporting systems.

6.1.3 Repeat Analysis

The TAMC's focus on gaining compliance with reporting requirements appears to be paying off in terms of the data that is being produced in the IRT. Successive years of IRT data will allow TAMC to separate year to year trends from background noise much like successive years of PASER data have done for forecasting on the overall trajectory of the paved federal aid eligible road system.

It is recommended that the analysis in this study be rerun every two years as normal TAMC business process. Data handling routines should be set up with the help of CSS to automate data processing following the general form of the analysis in this report.

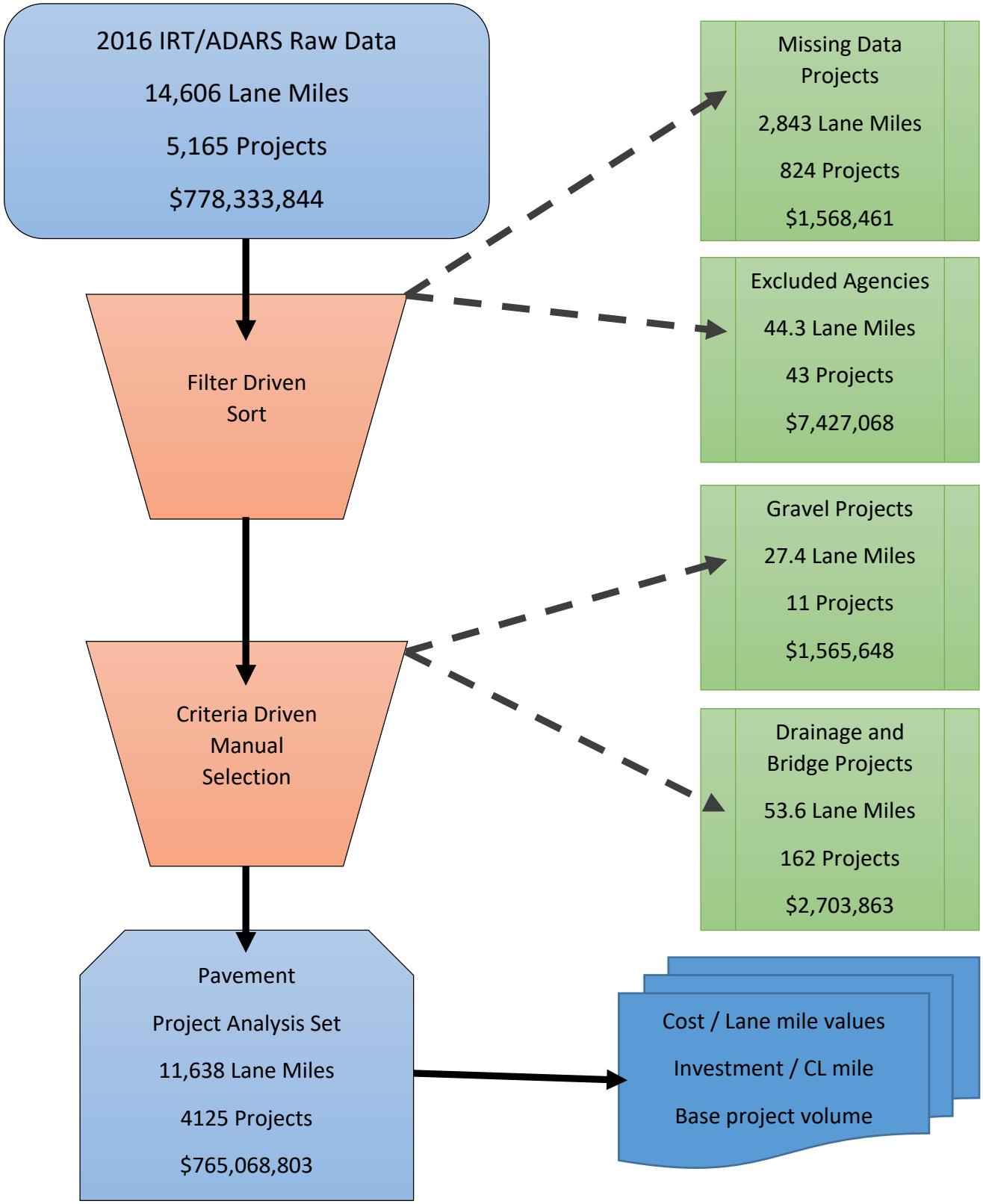
7 REFERENCES

WashDOT (2002). *Highway Construction Cost Comparision Survey.* Washington State Department of Transportation.

Hollar, D. (2011). *Predicting Preliminary Engineering Costs for Highway Projects.* Raleigh, North Carolina: North Carolina State University.

Hummer, J. E., Liu, M., & Rasdorf, W. J. (2011). *Preliminary Engineering Cost Trends for Highway Projects.* Raleigh Corth Carolina: North Carolina State University.

APPENDIX A: DATABASE FILTERING STATISTICS FOR 2016


2016 IRT/ADARS Raw Data
14,606 Lane Miles
5,165 Projects
$778,333,844
Filter Driven Sort
Criteria Driven Manual Selection
Pavement Project Analysis Set
11,638 Lane Miles
4125 Projects
$765,068,803
Missing Data Projects
2,843 Lane Miles
824 Projects
$1,568,461
Excluded Agencies
44.3 Lane Miles
43 Projects
$7,427,068
Gravel Projects
27.4 Lane Miles
11 Projects
$1,565,648
Drainage and Bridge Projects
53.6 Lane Miles
162 Projects
$2,703,863
Cost / Lane mile values
Investment / CL mile
Base project volume

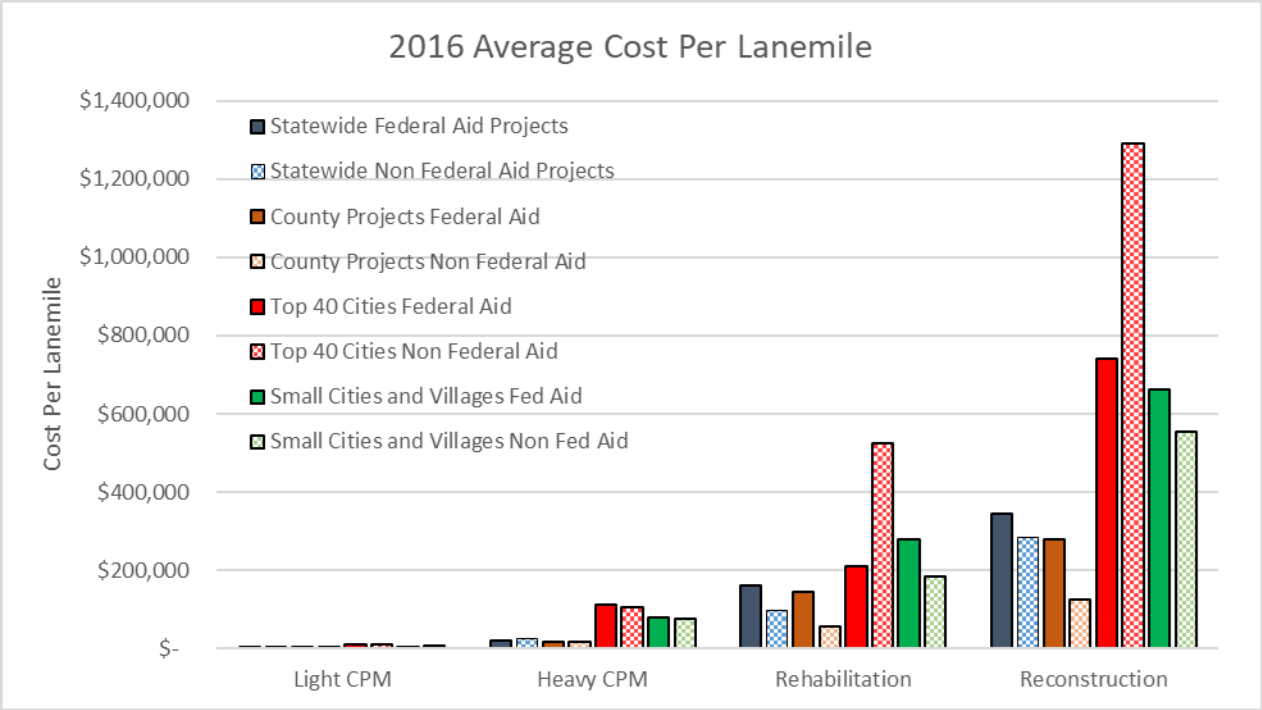
APPENDIX B COST PER LANE MILE TABLES AND GRAPHS

2017 IRT/ADARD Data

All Projects Statewide					
	# of Projects	Lane Miles	Total Dollars	% of Total	Dollars/LM
Light CPM	837	2,264.2	$ 10,840,529	1.55%	$ 4,788
Heavy CPM	1,756	5,547.3	$ 115,921,824	16.63%	$ 20,897
Rehabilitation	1,218	2,766.2	$ 321,777,460	46.15%	$ 116,326
Reconstruction	484	711.5	$ 248,712,003	35.67%	$ 349,545
Totals	***4,295***	***11,289.1***	***$ 697,251,816***		
Federal Aid Projects Statewide					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	400	1,672.5	$ 7,551,626	2%	$ 4,515
Heavy CPM	572	3,343.0	$ 67,114,433	17%	$ 20,076
Rehabilitation	419	1,600.7	$ 208,974,236	52%	$ 130,552
Reconstruction	168	350.7	$ 120,087,742	30%	$ 342,451
Totals	***1,559***	***6,966.9***	***$ 403,728,036***	100%	
Non Federal Aid Projects Statewide					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	437	591.6	$ 3,288,903	1%	$ 5,559
Heavy CPM	1,184	2,204.2	$ 48,807,391	17%	$ 22,143
Rehabilitation	799	1,165.5	$ 112,803,224	38%	$ 96,787
Reconstruction	316	360.9	$ 128,624,260	44%	$ 356,439
Totals	***2,736***	***4,322.2***	***$ 293,523,779***	100%	
County Projects					
Federal Aid Projects					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	245	1,178.2	$ 4,778,365	2%	$ 4,056
Heavy CPM	456	3,133.3	$ 50,429,678	21%	$ 16,095
Rehabilitation	300	1,260.8	$ 128,352,115	53%	$ 101,801
Reconstruction	88	267.7	$ 60,777,848	25%	$ 227,066
Totals	***1,089***	***5,840.0***	***$ 244,338,006***	100%	
Non Federal Aid Projects					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	161	400.4	$ 1,983,191	2%	$ 4,953
Heavy CPM	719	1,963.9	$ 32,397,339	29%	$ 16,496
Rehabilitation	481	903.2	$ 55,075,249	49%	$ 60,978
Reconstruction	137	242.4	$ 23,414,050	21%	$ 96,597
Totals	***1,498***	***3,509.9***	***$ 112,869,829***	100%	
Top 40 Cities					
Federal Aid Projects					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	72	199.4	$ 2,104,751	2%	$ 10,555
Heavy CPM	59	144.3	$ 10,376,560	9%	$ 71,891
Rehabilitation	52	269.6	$ 64,025,947	56%	$ 237,462
Reconstruction	26	42.3	$ 37,214,394	33%	$ 880,752
Totals	***209***	***655.6***	***$ 113,721,652***	100%	
Non Federal Aid Projects					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	128	104.1	$ 749,630	1%	$ 7,201
Heavy CPM	316	152.9	$ 10,284,936	8%	$ 67,251
Rehabilitation	164	160.9	$ 38,796,835	31%	$ 241,170
Reconstruction	68	63.3	$ 75,860,016	60%	$ 1,198,534
Totals	***676***	***481.2***	***$ 125,691,417***	100%	
Small Cities and Villages					
Federal Aid Projects					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	83	294.9	$ 668,510	1%	$ 2,267
Heavy CPM	57	65.4	$ 6,308,195	14%	$ 96,526
Rehabilitation	67	70.3	$ 16,596,174	36%	$ 236,204
Reconstruction	54	40.8	$ 22,095,500	48%	$ 542,194
Totals	***261***	***471.3***	***$ 45,668,378***	100%	
Non Federal Aid Projects					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	148	87.1	$ 556,083	1%	$ 6,385
Heavy CPM	149	87.4	$ 6,125,116	11%	$ 70,115
Rehabilitation	154	101.4	$ 18,931,140	34%	$ 186,685
Reconstruction	111	55.2	$ 29,350,195	53%	$ 531,947
Totals	***562***	***331.0***	***$ 54,962,533***	100%	

2016 IRT/ADARS Data

All Projects Statewide					
	# of Projects	Lane Miles	Total Dollars	% of Total	Dollars/LM
Light CPM	548	2,360.8	$ 7,555,942	1%	$ 3,201
Heavy CPM	1,771	5,813.0	$ 129,681,594	17%	$ 22,309
Rehabilitation	1,305	2,541.4	$ 334,206,901	44%	$ 131,507
Reconstruction	501	923.0	$ 293,624,367	38%	$ 318,128
Totals	***4,125***	***11,638.2***	***$ 765,068,803***	100%	
Federal Aid Projects STATEWIDE					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	245	1,963.1	$ 4,990,122	1%	$ 2,542
Heavy CPM	709	3,783.3	$ 79,030,618	16%	$ 20,889
Rehabilitation	401	1,344.0	$ 217,866,477	45%	$ 162,104
Reconstruction	174	533.0	$ 182,766,408	38%	$ 342,887
Totals	***1,529***	***7,623.5***	***$ 484,653,625***	100%	
Non Federal Aid Projects STATEWIDE					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	303	397.7	$ 2,565,820	1%	$ 6,451
Heavy CPM	1,062	2,029.7	$ 50,650,976	18%	$ 24,955
Rehabilitation	904	1,197.4	$ 116,340,423	41%	$ 97,163
Reconstruction	327	390.0	$ 110,857,959	40%	$ 284,285
Totals	***2,596***	***4,014.8***	***$ 280,415,178***	100%	
County Projects					
Federal Aid Projects					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	121	1,607.4	$ 1,879,283	1%	$ 1,169
Heavy CPM	602	3,588.3	$ 59,631,151	18%	$ 16,618
Rehabilitation	283	1,045.3	$ 149,574,769	44%	$ 143,097
Reconstruction	115	451.3	$ 125,519,185	37%	$ 278,111
Totals	***1,121***	***6,692.3***	***$ 336,604,387***	100%	
Non Federal Aid Projects					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	100	212.4	$ 947,122	1%	$ 4,460
Heavy CPM	826	1,792.6	$ 28,481,745	22%	$ 15,888
Rehabilitation	664	1,037.2	$ 58,654,699	46%	$ 56,550
Reconstruction	208	312.6	$ 39,280,005	31%	$ 125,671
Totals	***1,798***	***3,354.8***	***$ 127,363,571***	100%	
Top 40 Cities					
Federal Aid Projects					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	70	200.3	$ 2,405,044	3%	$ 12,006
Heavy CPM	52	123.5	$ 13,717,764	15%	$ 111,067
Rehabilitation	56	219.8	$ 46,333,430	50%	$ 210,806
Reconstruction	21	41.0	$ 30,313,301	33%	$ 739,656
Totals	***199***	***584.6***	***$ 92,769,540***	100%	
Non Federal Aid Projects					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	85	83.0	$ 929,214	1%	$ 11,197
Heavy CPM	86	139.4	$ 14,686,281	13%	$ 105,375
Rehabilitation	90	83.1	$ 43,445,820	40%	$ 523,003
Reconstruction	46	39.1	$ 50,423,336	46%	$ 1,289,336
Totals	***307***	***344.5***	***$ 109,484,651***	100%	
Small Cities and Villages					
Federal Aid Projects					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	54	155.4	$ 705,795	1%	$ 4,542
Heavy CPM	55	71.6	$ 5,681,703	10%	$ 79,407
Rehabilitation	62	78.9	$ 21,958,278	40%	$ 278,185
Reconstruction	38	40.7	$ 26,933,922	49%	$ 661,572
Totals	***209***	***346.6***	***$ 55,279,698***	100%	
Non Federal Aid Projects					
	# of Projects	Lane Miles	Total Dollars	% of Totals	Dollars/LM
Light CPM	118	102.3	$ 689,484	2%	$ 6,737
Heavy CPM	150	97.7	$ 7,482,950	17%	$ 76,577
Rehabilitation	150	77.1	$ 14,239,905	33%	$ 184,711
Reconstruction	73	38.3	$ 21,154,618	49%	$ 552,585
Totals	***491***	***315.4***	***$ 43,566,956***	100%	


2016 Average Cost Per Lanemile
Cost Per Lanemile
$1,400,000
$1,200,000
$1,000,000
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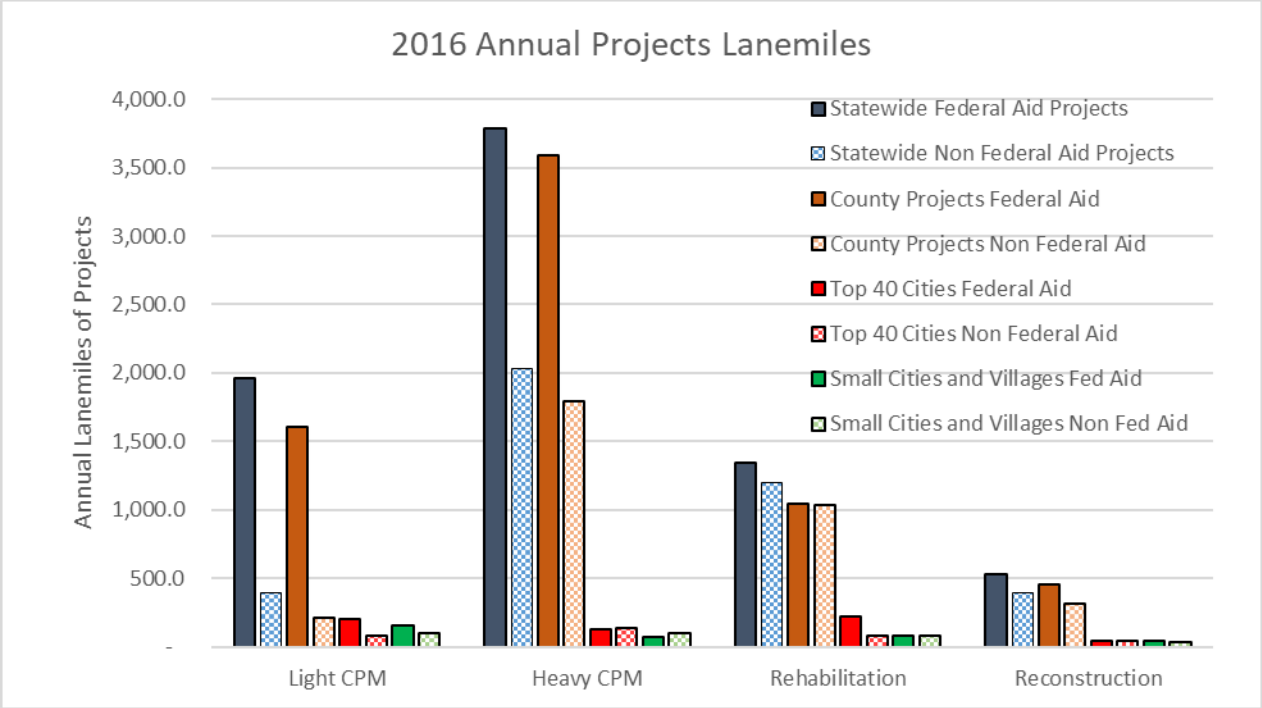
$-
Statewide Federal Aid Projects
Statewide Non Federal Aid Projects
County Projects Federal Aid
County Projects Non Federal Aid
Top 40 Cities Federal Aid
Top 40 Cities Non Federal Aid
Small Cities and Villages Fed Aid
Small Cities and Villages Non Fed Aid
Light CPM
Heavy CPM
Rehabilitation
Reconstruction


2016 Annual Projects Lanemiles
Annual Lanemiles of Projects
4,000.0
3,500.0
3,000.0
2,500.0
2,000.0
1,500.0
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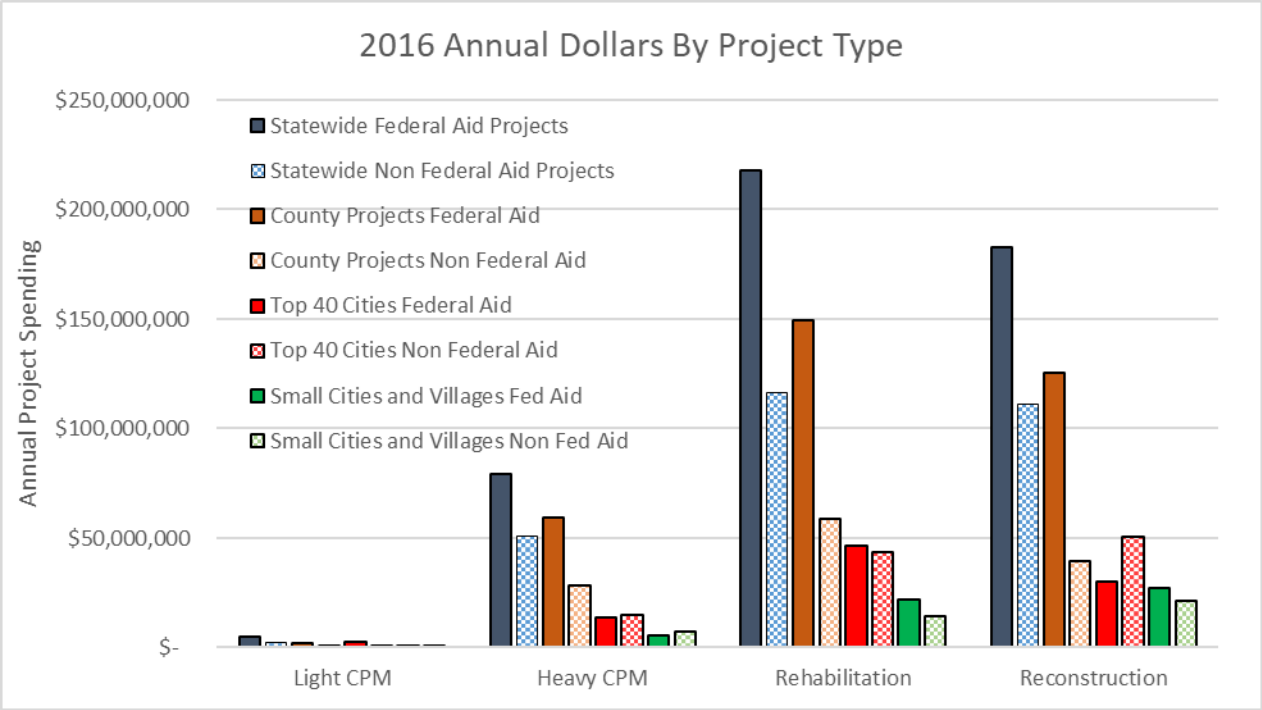
-
Statewide Federal Aid Projects
Statewide Non Federal Aid Projects
County Projects Federal Aid
County Projects Non Federal Aid
Top 40 Cities Federal Aid
Top 40 Cities Non Federal Aid
Small Cities and Villages Fed Aid
Small Cities and Villages Non Fed Aid
Light CPM
Heavy CPM
Rehabilitation
Reconstruction


2016 Annual Dollars By Project Type
$250,000,000
$200,000,000
$150,000,000
$100,000,000
$50,000,000
$-
Annual Project Spending
Statewide Federal Aid Projects
Statewide Non Federal Aid Projects
County Projects Federal Aid
County Projects Non Federal Aid
Top 40 Cities Federal Aid
Top 40 Cities Non Federal Aid
Small Cities and Villages Fed Aid
Small Cities and Villages Non Fed Aid
Light CPM
Heavy CPM
Rehabilitation
Reconstruction

APPENDIX C: AVERAGE WEIGHTED COST PER LANE MILE FOR COMMON TREATMENTS

2016 & 2017 County Projects

TAMC Class	Project Subcategory	# of Projects	Lane Miles	Total Project Dollars	$/LM
Heavy CPM	Chip Seal	1809	7775.7	$ 94,362,306	$ 12,136
Heavy CPM	Slurry or Cape Seal	68	438.3	$ 7,550,493	$ 17,228
Heavy CPM	Micro Surfacing	56	205.1	$ 6,422,093	$ 31,312
Heavy CPM	Ultra Thin Overlay	98	271.6	$ 10,034,560	$ 36,951
Heavy CPM	Mill and Fill - Non Structural	143	188.3	$ 14,153,379	$ 75,145
Heavy CPM	Overlay - Non Structural	439	946.0	$ 42,039,080	$ 44,439
Rehabilitation	Mill and Fill - Structural	88	220.2	$ 24,929,138	$ 113,215
Rehabilitation	Overlay - Structural	507	968.0	$ 85,237,119	$ 88,058
Rehabilitation	Crush and Shape	302	818.5	$ 116,191,356	$ 141,963
Rehabilitation	Minor Rehab	112	223.7	$ 5,534,475	$ 24,741
Rehabilitation	Major Rehab	48	333.9	$ 40,293,758	$ 120,660
Rehabilitation	Resurfacing	471	1222.3	$ 90,615,807	$ 74,138
Reconstruction	Reconstruction	372	814.6	$ 212,347,535	$ 260,664

2016 & 2017 Top 40 City Projects

TAMC Class	Project Subcategory	# of Projects	Lane Miles	Total Project Dollars	$/LM
Heavy CPM	Chip Seal	50	98.8	$ 1,737,572	$ 17,583
Heavy CPM	Slurry or Cape Seal	5	46.5	$ 1,629,774	$ 35,032
Heavy CPM	Micro Surfacing	175	63.3	$ 2,239,182	$ 35,376
Heavy CPM	Ultra Thin Overlay	0	0.0	$ -	
Heavy CPM	Mill and Fill - Non Structural	68	95.1	$ 13,591,431	$ 142,889
Heavy CPM	Overlay - Non Structural	147	131.8	$ 14,958,746	$ 113,476
Rehabilitation	Mill and Fill - Structural	43	39.9	$ 10,428,611	$ 261,055
Rehabilitation	Overlay - Structural	33	58.0	$ 14,307,971	$ 246,685
Rehabilitation	Crush and Shape	54	50.1	$ 13,729,087	$ 273,941
Rehabilitation	Minor Rehab	16	76.9	$ 13,290,333	$ 172,833
Rehabilitation	Major Rehab	10	7.4	$ 9,525,478	$ 1,287,923
Rehabilitation	Resurfacing	168	412.6	$ 120,693,726	$ 292,551
Reconstruction	Reconstruction	144	155.5	$ 131,429,497	$ 845,445

2016 & 2017 Small City and Village Projects

TAMC Class	Project Subcategory	# of Projects	Lane Miles	Total Project Dollars	$/LM
Heavy CPM	Chip Seal	59	62.7	$ 1,155,266	$ 18,420
Heavy CPM	Slurry or Cape Seal	39	25.3	$ 781,106	$ 30,854
Heavy CPM	Micro Surfacing	2	2.3	$ 78,078	$ 33,467
Heavy CPM	Ultra Thin Overlay	17	16.5	$ 560,961	$ 33,971
Heavy CPM	Mill and Fill - Non Structural	201	153.5	$ 17,201,496	$ 112,046
Heavy CPM	Overlay - Non Structural	66	55.2	$ 6,982,696	$ 126,489
Rehabilitation	Mill and Fill - Structural	49	24.7	$ 3,529,286	$ 143,071
Rehabilitation	Overlay - Structural	26	18.3	$ 1,797,943	$ 98,179
Rehabilitation	Crush and Shape	118	72.0	$ 13,808,523	$ 191,710
Rehabilitation	Minor Rehab	14	7.6	$ 1,944,668	$ 256,316
Rehabilitation	Major Rehab	43	31.7	$ 13,062,479	$ 412,118
Rehabilitation	Resurfacing	171	127.3	$ 31,558,648	$ 247,845
Reconstruction	Reconstruction	250	156.8	$ 91,861,717	$ 586,021

TAMC 2017 - 2019 Work Program
Progress as of December, 2018
New items in bold & italics
NOTE: Now printable on 8 1/2" x 11" paper

Work Product		Tasks	2019	Status	Notes
PA 325					
	Training	Revise Training Programs			
		Revise budget for new training needs			
	Modeling	Develop an understanding of asset deterioration			
		Make deterioration rates available to the public			
	AM Plans	Update/Create Asset Management Plan Template			
		Develop a 3-year schedule for plan submission by top 123 (agencies with >100 miles)	***√***	***3-year scbedule identified and agencies notified***	
		Develop a process for submittal and approval of AM plans			
	Coordinate with WAMC/MIC	Coordinate asset condition approach with WAMC/MIC			
		Define age of construction across assets			
		Coordinate on transparency and what needs to be shared			
		Attend/monitor MIC meetings			
		Attend/monitor WAMC meetings			
	Data Collection	Data Governance and standards for culverts			
		Data Governance and standards for signals			
		Leverage technology for data collection			

Work Product	Tasks	2019	Status	Notes
Staff	Identify staff and budget needed to comply			

	Work Product	Tasks	2019	Status	Notes
Communications					
1	Press Releases	Continue publishing press releases as appropriate	Ongoing		Past Press Releases are on the website
2	Monthly Summary of TAMC Activities & Initiatives	Seek feedback on larger issues	Ongoing		As necessary on appropriate agenda items
3	Outreach with Stakeholders	Regional Coordinator Call	Ongoing	Calls ongoing since April	
		Query how is info shared with partner agencies			
4	Support TAMC Partner Agencies at Conferences	Develop schedule of conferences/topics		***2019 Schedule provided for discussion***	
		Coordinate TAMC attendees			
Publications					
1	**ANNUAL REPORT ***	Compile and submit to Legislature by May			
		Develop detailed schedule with milestones	***√***		
		Get feedback from conference attendees		Customer Satisfaction Survey gave value of Annual Report adequate marks (3.7/5)	Should we make this a standard question at conferences?
		Marketing assessment			ACE gave this medium priority
2	Website Update	Maintain website	ongoing		Dave J is trained to update the website
		Define Support Role	***√***		
3	"Bridge" Newsletter	Develop schedule w/ milestones & who is writing	ongoing	MTU completed September article on Culvert pilot project	***Next article to be about PA 325 requirements - is MTU writing this?***

Work Product		Tasks	2019	Status	Notes
4	Other Publications	Investigate other opportunities to highlight TAMC	ongoing		When TAMC has something newsworthy to share, staff will develop material to include in members' constituent newsletters
Public Outreach					
1	Promote Roadsoft as AM Platform	Continue to assist MTU-CTT in deployment of Roadsoft	ongoing		
2	Website Interactive Maps	Overall coordination/updates	ongoing		
		Update cycle related to TAMC activity	ongoing		
		Continual improvement	ongoing		
3	Dashboards	Overall coordination/updates	ongoing		
		Continual review of new/revised dashboards			Upgrades made in 2018
		Timely updates scheduled, define & implement			CSS updated to reflect 2018 annual report data
4	Mobile Apps	Maintain mobile apps	ongoing		interactive map is now tablet and phone friendly
		Update as needed	ongoing	dashboard mobile app still to come	
		Lessons learned			Who would best evaluate this?
5	TAMC Awards	Continue program			ACE gave this high priority
		Evaluate & update selection process			ACE gave this lower priority to be addressed later in 2018
6	Social Media	Explore social media platforms			ACE gave this medium priority

Work Product		Tasks	2019	Status	Notes
Awareness of Asset Management					
1	21st CIC	Monitor progress - tasks TBD			
		Track activities			
		Data governance & sharing			
		Utility coordination			
		Culvert Pilot Project		Report transmitted to Governor's office in September	
Data Collection					
1	**COLLECT PASER DATA ***	Collect data on no less than 1/2 FA paved	ongoing	2018 data collection begins in April	
		Perform QC on PASER ratings	ongoing	Consultant hired by MDOT to do this; will speak to Data Committee in March	
		Continue use of IRT to upload data sets	ongoing	***FY2017 97% complete; FY2018 submittals have begun***	Updates provided monthly
2	Review Collection Methods & Reimbursement Policy for FA and Non-FA Networks (Paved & Unpaved)	Research cost-effectiveness of data collection effort	ongoing	On hold until better data available based on new data collection policy, per Data Committee	Data Committee assigned this high priority, but would like better costs per mile first
		Focus efforts to collect data on top 123 (agencies with > 100 miles)		PA 325 increases focus on this	Data Committee assigned this lower priority
	Bridges	Anticipate changes - new nat'l requirements			

Work Product		Tasks	2019	Status	Notes
4	Ensure Framework Base Map is Current	Update data sets within Framework	ongoing		framework base map & Act 51 maps not the same; to be corrected as identified
		Develop business needs for RFPs		ACE to discuss as part of budget discussion	"Best Value" bid process would run thru MDOT, RFP prepared by council or subcommittee
		Subject matter expert input & feedback	ongoing		Raters provide feedback on corrections as they find them
5	Data Collection Models	Continue Roadsoft promotion to Act 51 agencies	ongoing		
		Maintain Markov model in working order	ongoing	Data Committee has begun to discuss data analysis options	
7	Asset Management Plans	Prep & training for development of agency AM plans		***Upcoming Training December 2018***	
		Focus efforts to collect plans from top 123 (agencies with > 100 miles)		***PA 325 requirements address this***	

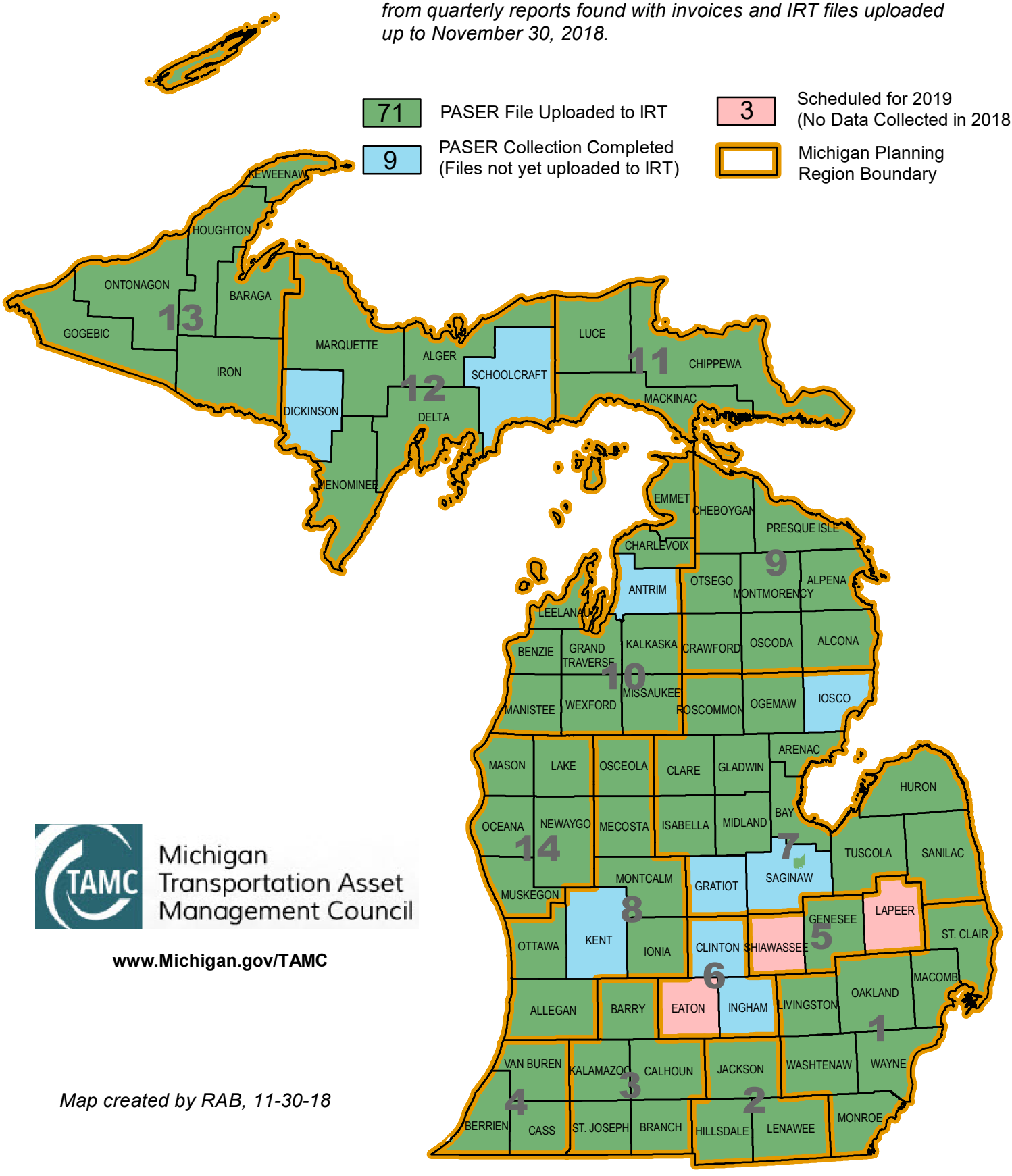
	Work Product	Tasks	2019	Status	Notes
Training & Education					
1	**PASER & IRT TRAINING ***	Continue training		***2019 Schedule Available on website***	
		Identify attendees & report results			
		Identify success/failure & report results	ongoing	***Do TAMC want to make a special effort to market training?***	Customer Satisfaction Survey gave training high marks(4.38/5); participation could be better as only just more than half of respondants had attended training
2	Local Officials Training & Workshops	Training gap analysis			
		Informational tools			
		Update as necessary	ongoing		
3	New AM Training	Operational aspects of AM			
		Update as necessary	ongoing		
4	Inventory-based Rating Training	Develop and deliver training program	***ongoing***		
	Informational Tools	Pilot two 90-second videos			ACE assigned this low priority
6	Continued Education w/ Legislature	Customized pamphlet/brochure by lege district		MPOS and regions do an annual report of paser condition	
		Set up event w/ legislators		Referred to ACE; would need to seek assistance/support from MITA	ACE gave this high priority

Work Product		Tasks	2019	Status	Notes
7	Bi-Annual Conference	Continue coordinating conference(s)	ongoing	***Next conference May 2019, partnering with APWA MI***	
		Identify attendees & report results	ongoing		
		Identify success/failure & report results	ongoing		
Data Analysis & Resarch Opportunities					
1	**IRT DATA ***	Integration between PASER & IRT	ongoing		
		Data quality	ongoing		
		Analyze Best & Worst practices			Data committee discussed in September; more conversation likely needed
2	Data Storage & Design Reports - Recommendations for Optimal Use	Assessment		2018 rewrite of IRT with enhanced reporting should address this	
		Update requirements working w/ stakeholders			
		Report		CSS working on an update	Data Committee assigned this high priority
3	Forecasting	Review new IRT data for forecasting tools		In process	Data Committee assigned this medium priority

	Work Product	Tasks	2019	Status	Notes
Project & Investment Reporting					
	Fields Inquiring about AM Process	Compare & analyze AM plans & data from IRT with PASER and Bridge data		***Data committee discussed potential research problem statement in Summer 2018***	Data Committee assigned this high priority
		Analyze plan elements & components; present agencies that are high performers		after data committee completes analysis	
		Communication plan		included in MPOs and RPO's 2018 UWP	
3	Continuing Compliance Monitoring	Analysis & reporting	ongoing	support staff working with MDOT Act 51 team; monthly status updates reported at Data Committee	
		Continue monitoring on how compliance is being done	ongoing		
4	Quality Control (IRT)	Assess & report on quality of information			ad hoc approach
		Update 2009 Cost Investment Report			still to come
Performance Measures					
1	Develop Measures for TAMC	Implementation of Work Program	ongoing	summary provided monthly	
		IRT-ADARS		summary provided monthly	
		Miles collected		summary provided monthly	
		Number of Asset Management Plans rec'd		Data committee to consider monthly	
		Council budget spent/reporting		summary provided monthly	
		Develop more as needed		Culvert Project measures of success?	
2		Determine where there's duplication of effort	ongoing		
	* denotes items required by law				

2018 - PASER Status by County As of November 30

Map indicates completion status of TAMC sponsored Federal Aid PASER Data Collection as reported by Regional Planning Agency Coordinators. Data also includes updates from previous calls and from quarterly reports found with invoices and IRT files uploaded up to November 30, 2018.



Michigan Transportation Asset Management Council

www.Michigan.gov/TAMC

Map created by RAB, 11-30-18

Michigan Transportation Asset Management Council

Policy for Data Sharing

The Transportation Asset Management Council adopted this policy on _____.

Introduction:
The Transportation Asset Management Council (TAMC) was established to expand the practice of asset management statewide to enhance the productivity of investing in Michigan's roads and bridges. One of TAMC's efforts is to provide through its website dashboards consistent data related to physical inventory and condition of roads and bridges, and infrastructure investment. Some of this data is generated by TAMC data collection efforts, some comes from other sources. This document describes the policy and procedures for sharing data upon request.

Data Sharing and Dashboards:
TAMC's data – and other related data – is already made publicly available through its dashboards.

Upon receiving a request for data from a member of the public, TAMC will provide information about how to access the dashboards to gather data. TAMC will provide the link to the data and the requester can obtain it and format it as needed. TAMC is not obligated to expend significant staff time or resources to provide data to requesters in a format beyond that available on the website dashboards.

Freedom of Information Act Requests
An individual may request data from TAMC through the Freedom of Information Act (FOIA). Any TAMC member or TAMC support staff who receives such a request will forward that request immediately to the TAMC coordinator. The TAMC coordinator will then work with MDOT's FOIA Coordinator to ensure the FOIA request is handled in a timely fashion consistent with the procedures of MDOT's FOIA policy. More information can be found online about FOIA's procedures and guidelines. A pamphlet about FOIA can be found here.

If you have any questions relating to this policy, please contact:
TAMC Asset Management Coordinator
Michigan Department of Transportation
P.O. Box 30050, 425 W. Ottawa Street
Lansing, MI 48909
(517) 335.4580
www.michigan.gov/tamc

Michigan Transportation Asset Management Council

Policy for Collection of Roadway Surface Condition Data

The Transportation Asset Management Council adopted this policy on _____.

Introduction:
The Transportation Asset Management Council (TAMC) was established to expand the practice of asset management statewide to enhance the productivity of investing in Michigan's roads and bridges. Part of the TAMC's mission is to collect physical inventory and condition data on all roads and bridges in Michigan. This document describes the policy and procedures for collecting the physical inventory and surface condition data of paved and unpaved roads and streets owned by Public Act 51 agencies on the Federal Aid eligible and Non-Federal Aid eligible within Michigan. The TAMC has a TAMC Asset Management Coordinator who is responsible for the support and operation of the TAMC activities.

According to Act 51 (P.A. 499 2002, P.A. 199 2007); each Local Road Agency and the Michigan Department of Transportation (MDOT) shall annually report to the TAMC the mileage and condition of the road and bridge system under their jurisdiction. Additionally, procedures and requirements developed and presented by the TAMC shall, at a minimum, include the areas of training, data storage and collection, reporting, development of a multiyear program, budgeting and funding, and other issues related to asset management.

The TAMC has given the responsibility of managing the TAMC work program to the Regional Planning Organizations (RPO)/Metropolitan Planning Organizations (MPO). The RPO/MPOs have TAMC work activities included in their annual work programs and have funds allocated from the TAMC for those activities. The RPO/MPO will have to allocate those funds among eligible work activities in order to best complete the priorities of the TAMC. Therefore the RPO/MPO may need to limit its authorizations for reimbursements in order to manage its work programs.

This policy applies to the collection of roadway surface condition data on:

- Federal-aid (FA) eligible network of public roads and streets using the Pavement Surface Evaluation and Rating system (PASER),
- Non-Federal-aid (NFA) eligible network of public roads and streets using the PASER system, and
- Unpaved roads and streets on either the FA or the NFA networks using the Inventory Based Rating™ (IBR) system.

Rating Teams

NOTE: Refer to the *PASER Training/Certification* Requirements section of this policy for training and certification requirements.

Data collection logs MUST contain rating team members' or observers' names and agencies, mileage, rating dates, and rating times. Although the TAMC supports interest by others in the data collection process, observers will not be reimbursed by the TAMC for their time.

FA Rating Teams
Rating teams must be comprised of a minimum of three raters: one (1) member from MDOT, one (1) member from the RPO/MPO and one (1) member/representative from the Act 51 road agency being rated (County, City/Village). All of these members must meet the training and/or certification requirements.

Additional participants may be included however, they must meet the training/certification requirements in order to be reimbursed with TAMC funds through the RPO/MPO for their effort. Although the TAMC supports interest by others in the data collection process, observers will not be reimbursed by the TAMC for their time.

NFA Rating Teams

a. If TAMC reimbursement for NFA data collection has not been approved, but the agency would like condition data included in TAMC's state wide database:

The Act 51 road agency may establish their own collection schedule and collect data on their NFA network.

The rating team shall consist of a minimum of one rater: one (1) member/representative of the Act 51 road agency who meets the training and/or certification requirements.

The TAMC encourages all rating team participants to follow their agency's safety procedures and practices.

b. If TAMC reimbursement is being requested:

Road agencies must receive authorization prior to gathering any data from the RPO/MPO for reimbursement for NFA data collection.

Road agencies must submit a written request for reimbursement; the request should include the miles of NFA rated and the total estimated cost (actual costs claimed must not exceed the estimated costs) for the data gathering, trained/certified team members' time, and vehicle use. This request must also clarify which fiscal year the data collection and reimbursement will take place. Requests for NFA data collection reimbursement authorization are required to be received by the RPO/MPO by October 1.

The RPO/MPO decision on what requests for reimbursement are approved will consider:

- available budget,
- absence or age of the NFA data that will be collected,
- last year of reimbursement to the road agency for that NFA data set. No more frequently than once every three [3] years),
- rating team members' training and/or certification status

The rating team shall consist of a minimum of two (2) people: one (1) member/representative of the Act 51 road agency who meets the training and/or certification requirements and one (1) member who the Act 51 road agency chooses to represent it, RPO/MPO, Act 51 agency staff or others. Untrained or uncertified raters will not be reimbursed. Although the TAMC supports interest by others in the data collection process, observers will not be reimbursed by the TAMC for their time.

The TAMC encourages all rating team participants to follow their agency's safety procedures and practices.

PASER Training/Certification Requirements:

Training:

- Any rater who participates in the PASER data collection and influences the rating

activity MUST attend an on-site PASER training in the same year the data collection occurs.
- New raters (never attended PASER training before) and seasoned raters (who did not attend PASER training the year prior) MUST attend one (1) supplemental PASER webinar training session in addition to attending one (1) on-site session.
- Individuals who are PASER Certified Raters are exempted from on-site training as defined in PASER Certification Eligibility Requirements section of this policy.
- Any rater who participates in the data collection for unpaved roads shall attend IBR training within three years of the year IBR data collection is conducted.
- New IBR raters (never attended IBR training before) and seasoned raters (who did not attend IBR training within three calendar years of the IBR data collection) MUST attend one (1) IBR training session.
- RPO/MPO representatives are required to attend PASER and IBR training events every year regardless of their experience or certification status. RPO/MPO representatives are critical to the success of the PASER data collection effort, so it is important for them to continue to promote and support the program by attending on-site events.

Certification Eligibility Requirements:
To be considered a candidate to take the PASER certification exam the rater must meet the following criteria:

- All raters: Six (6) or more years (not including current year) of attendance of PASER on-site training as verified through the Center for Technology & Training (CTT) records.
- Raters who are licensed professional civil engineers: Three (3) or more years (not including current year) of attendance of PASER on-site training as verified through CTT records.
- Raters who actually rated a portion of their road network during TAMC collection for the same number of years trained (not including current year). This will be verified by a signed letter from the individual stating their rating experience.
- Raters who attended the annual TAMC PASER on-site training portion of the workshop as well as the examination administration portion of the workshop.

Certification Exam:
- The written certification exam will be administered at the on-site sessions of PASER training to eligible candidates.
- Raters must pass the written certification exam during the on-site training sessions. The passing score is 70% correct or will be adjusted using the normal distribution (bell curve) of the scores depending on the difficulty of the exam questions at the discretion of CTT staff.
- Raters who do not pass the certification exam will be able to attend another on-site PASER training session and retake the exam as many times in one year as space and CTT administration allows.
- The TAMC will hold exam results and exam questions as documents that are not open to the public without a freedom of information act request to prohibit development of files of exam questions that can be used to memorize facts rather than learning concepts.

There is no current certification exam for IBR (unpaved road) data collection.

Certification Responsibilities:

- Certified raters are required to attend on-site PASER training every other year; i.e. a two (2) year cycle to recertify by taking the certification exam.
- Certified raters are required to attend an organizational webinar for updates to business rules and changes to the data collection process as necessary. This webinar is required to keep certified raters informed of new guidance in the program and provides raters with an opportunity to interact with TAMC members.

MDOT Region Representative Responsibilities

NOTE: Each MDOT Region must designate a MDOT Region Representative to be a contact source for the TAMC.

- Ensuring that a trained and/or certified MDOT rater participates on the rating team for the annual FA data collection.
- Providing an MDOT vehicle for the annual FA data collection.
- Ensuring non-MDOT members of rating team are provided with State of Michigan travel and reimbursement rate schedules at the start of the rating season.

RPO/MPO Regional Coordinator Responsibilities

NOTE: Each RPO/MPO must designate a RPO/MPO Regional Coordinator to be a contact source for the TAMC.

- Establishing the data collection schedule and coordinating the dates for FA road rating with the respective rating teams.
  NOTE: The TAMC outlines policies for the data collection cycle schedule as well as first and last days of annual data collection in the *Data Collection* section.
- Ensuring/verifying the rating team has the required number of trained and/or certified raters from the Act 51 road agency(ies) collecting the road surface condition data (see the *Rating Teams* and the PASER Training/Certification Requirements sections of this policy for more information).
- Ensuring daily data collection logs which MUST contain team members or observers' names and agency, mileage, rating dates and time are accurately completed for each day of reimbursable data collection.
- Verifying/checking the miles of road surface condition data collected.
- Performing quality control checks of the data collected.
  NOTE: The RPO/MPO Regional Coordinator MUST review the collected data—looking for missing entries (zeros), valid surface type, missing surface type, valid number of lanes, missing lane information, and large increases/decreases in PASER scores for road segments that have had no treatments—before sending it to the Center for Shared Solutions (CSS).
- Ensuring that the completed PASER data export file is the correct file type and submitting the PASER data export file to the CSS (see the *Data Submission/Standards* section of this policy for more information).
- Submitting RPO/MPO invoices for reimbursement to the TAMC Asset Management Coordinator monthly or quarterly for all expenses related to training, data collection efforts, quality control, and data submission activities. Including copies of daily collection logs and any other backup information as attachments to the invoice.

Data Collection

- FA data collection must be completed in a two- (2) year cycle for the entire FA network.

- NFA data collection is encouraged with or without TAMC reimbursement.
- Each rating team must complete the following logs when being reimbursed for their work:
    - Daily data collection logs which MUST contain team members or observers' names and agency, mileage, rating dates and time are accurately completed for each day of reimbursable data collection.
    - Prepare a list that includes rater's names and agencies, as well as the certification that all raters were appropriately trained/certified.
- Data collection on paved roads must be consistent with the current *TAMC PASER Training Manual*, the *Sealcoat Revised Rating Guide for Michigan*, and, when appropriate, the *Asphalt, Concrete*, and *Sealcoat PASER Manuals* (accessible at http://michiganltap.org/paser-resources).
- Data collection on unpaved roads and streets must be consistent with the current IBR training and the *IBR Field Guide*.
- The use of the Roadsoft Laptop Data Collector (LDC) is required.
- The first day for data collection shall be the first Monday in April of each year; the last day for data collection shall be the last Friday in November of each year.

Data Submission/Standards

- FA/NFA data collected is to be submitted to the CSS by the RPO/MPO Regional Coordinator, who will submit the data following quality assurance and quality control guidelines.
- The export file from Roadsoft MUST be in a shapefile format; exports containing text files are not accepted. See the current *TAMC PASER Training Manual* (accessible at http://michiganltap.org/paser-resources) for additional information**.**
- The deadline for the RPO/MPO Regional Coordinator to submit the data to the CSS is the first Friday of December.

Reimbursement

Note: Act 51 road agencies must receive prior authorization from the RPO/MPO for reimbursement for NFA data collection. Please refer to the earlier section on NFA Rating Teams: b. If TAMC reimbursement is being requested section.

The TAMC has given the responsibility of managing portions of the TAMC work program to the RPO/MPOs. The RPO/MPOs have TAMC work activities included in their annual work programs and have funds allocated from the TAMC for those activities. The RPO/MPO will have to allocate those funds among eligible work activities in order to best complete the priorities of the TAMC. Therefore the RPO/MPO may need to limit its authorizations for reimbursements in order to manage its work programs and will work with its members to coordinate activities.

- Rating team members who represent MDOT will be reimbursed by the TAMC via annual approved budget for PASER review.
- Rating team members who represent the RPO/MPO will be reimbursed via annual project authorization with the TAMC.
- Rating team members who represent Act 51 (county, city, or village) road agencies will be reimbursed, for FA data collection and, with prior authorization, for NFA data collection activities, and for expenses directly related to the data collection effort (i.e., time, travel, meals, vehicle) via annual RPO/MPO project authorization with the TAMC. The TAMC will not directly reimburse Act 51 road agencies. Act 51 road agencies shall submit invoices and supporting information to the RPO/MPO for costs associated with PASER data collection that has

been authorized by the RPO/MPO. The RPO/MPO will request payment from MDOT and subsequently reimburse the road agency following receipt of payment from MDOT.

- The RPO/MPO Regional Coordinator will submit invoices for reimbursement to the TAMC Asset Management Coordinator monthly or quarterly for all expenses related to training, data collection efforts, quality control, any Act 51 road agency's associated cost invoice(s) detailing expenses directly related to data collection (i.e., time, travel and/or meal reimbursements), and data submission activities. Time, travel and/or meal reimbursements will be processed according to State of Michigan travel and meal rates. Copies of daily collection logs and any other backup information will be included as attachments to the invoice.

If you have any questions relating to this policy, please contact:

TAMC Asset Management Coordinator
Michigan Department of Transportation
P.O. Box 30050, 425 W. Ottawa Street
Lansing, MI 48909
(517) 335.4580
www.michigan.gov/tamc

Reporting Period: Sept. 1 - 30, 2018

Monthly Project Progress Report

TAMC Training 2018

November 13, 2018

Project Manager: Roger Belknap

MDOT Contract 2018-0067 Authorization Z1

Contract Dates: 01/01/2017 – 12/31/2017

Contract Amount: $234,534

Michigan Technological University
1885

Center for Technology & Training

Michigan Technological University
1400 Townsend Drive
Houghton, MI 49931

Task	% of Budgeted Dollars Spent	Notes
Assist Coordinating the MI Transportation Asset Management Conferences	63%	
Conduct MI Transportation Asset Management Workshops	17%	
Conduct Introduction to Transportation Asset Management for Local Officials Training	43%	Completed two training sessions.
Conduct TAMC PASER Training	93%	Task Completed - 10 on-site PASER trainings and four webinars .
Conduct Inventory Based Rating Training	39%	Task Completed -four IBR training webinars.
Create IBR Booklet	13%	
Conduct Michigan Bridge Asset Management Workshop	42%	Completed two on-site workshops and one each Part 1 & Part 2 webinars.
Conduct Workshop on Creating Asset Management Plans	22%	
Project Management and Reporting	63%	

Tasks Completed

Reviewed the TAMP requirements, worked on planning the Asset Management Plans workshop and creating materials; continue to work on revisions to the draft IBR manual; scheduled and worked on flyers for two additional TAM for LO sessions; worked on developing materials for the fall TAM Conference and made travel arrangements; began working on scheduling the 2019 PASER training dates and securing venues; worked on scheduling two AM workshops; completed the August report and general project management.

Project's Financial Summary

September Expense Reimbursement Submitted	$2,290
Total Project Expense Reimbursements to Date	$130,534
Contract Balance Available	$104,000

Reporting Period: Oct. 1 - 31, 2018

Monthly Project Progress Report

TAMC Training 2018

November 13, 2018

Project Manager: Roger Belknap

MDOT Contract 2018-0067 Authorization Z1

Contract Dates: 01/01/2017 – 12/31/2017

Contract Amount: $234,534

Michigan Technological University
1400 Townsend Drive
Houghton, MI 49931

Task	% of Budgeted Dollars Spent	Notes
Assist Coordinating the MI Transportation Asset Management Conferences	102%	Spring and Fall Conferences are completed.
Conduct MI Transportation Asset Management Workshops	47%	Two sessions scheduled in November.
Conduct Introduction to Transportation Asset Management for Local Officials Training	47%	Completed two training sessions. Two more are scheduled in December.
Conduct TAMC PASER Training	96%	Task Completed - 10 on-site PASER trainings and four webinars .
Conduct Inventory Based Rating Training	39%	Task Completed - four IBR training webinars.
Create IBR Booklet	13%	
Conduct Michigan Bridge Asset Management Workshop	48%	Completed two on-site workshops and two Part 1 & one Part 2 webinars.
Conduct Workshop on Creating Asset Management Plans	48%	Four sessions scheduled in December.
Project Management and Reporting	63%	

Tasks Completed

Final planning and preparations for the Fall AM Conference, printed materials, packed equipment and traveled to Marquette to set up, present and manage the conference; scheduled the dates and locations for the asset management workshops, secured the venues, created flyer, emailed announcement and worked on updating the workshop materials; finalized locations for two more AM for LO sessions, finished the flyer and emailed announcement; scheduled all the PASER and IBR webinars for 2019 and finalized the flyer; reviewed IBR manual and brainstormed additions to it and uploaded potential photos; final arrangements and printed materials for the Bridge AM workshop in November; set up webinar

room and moderated the final part 1 session of the bridge AM webinar; determined locations, researched and locked down venues, created the flyer and emailed announcement for 4 sessions of asset management plan workshops; general project management.

Project's Financial Summary

October Expense Reimbursement Submitted	$10,088
Total Project Expense Reimbursements to Date	$140,622
Contract Balance Available	$93,912

Reporting Period: Sept. 1 - 30, 2018

Monthly Project Progress Report

TAMC Activities 2018

November 13, 2018

Project Manager: Roger Belknap

MDOT Contract 2014-0952 Authorization Z15

Contract Dates: 10/01/2017 – 9/30/2018

Contract Amount: $263, 946

Michigan Technological University

Center for Technology & Training

Michigan Technological University
1400 Townsend Drive
Houghton, MI 49931

Task	% of Budgeted Dollars Spent	Notes
Attend Council Meetings	42%	
Attend Committee Meetings	44%	
Culvert Pilot	126%	Completed
Review Data Collection & QC Collection Results	25%	
Maintain Roadsoft-IRT Data Submission Protocols	63%	
Maintenance of PASER Training Cert. Testing Instruments & Records	14%	
Investment Reporting Project Cost and Treatment Life Study	214%	Completed
Undefined Staff Support	28%	
Project Management & Monthly Reporting	133%	

Current Tasks Completed

Attended Data Committee Meeting via telephone; continued to work on the culvert pilot report, traveled to Lansing to meet with the TAMC Bridge Committee for the final report discussions, worked on report updates, proof-reading, final edits and report wrap-up; worked on analyzing treatments in Roadsoft and database work for the IRT cost study, worked on analyzing the data and report writing, reviewed, edited and finalized the IRT report; testing report issues with the IRT data submission protocols, testing discrepancy discussions with CSS and updated report with test segments; completed August report and general project management.

Reporting Period: Sept. 1 - 30, 2018

Project's Financial Summary

September Expense Reimbursement Submitted	$68,983
Total Project Expense Reimbursements to Date	$286,003
Contract Balance Available	($22,057)

Reporting Period: Oct. 1 - 31, 2018

Monthly Project Progress Report

TAMC Activities 2019

November 13, 2018

Project Manager: Roger Belknap

MDOT Contract 2018-0057 Authorization Z3

Contract Dates: 10/01/2018 – 9/30/2019

Contract Amount: $118,203

Michigan Technological University
1400 Townsend Drive
Houghton, MI 49931

Reporting Period: Oct. 1 - 31, 2018

Task	% of Budgeted Dollars Spent	Notes
Attend Council Meetings	0%	
Attend Committee Meetings	0%	
Review Data Collection & QC Collection Results	0%	
Maintain Roadsoft-IRT Data Submission Protocols	0%	
Maintenance of PASER Training Cert. Testing Instruments & Records	0%	
Revision of the TAMC AM Plan Templates for Roads and Bridges	18%	
Undefined Staff Support	0%	
Project Management & Monthly Reporting	8%	

Current Tasks Completed

Meeting to discuss work on the template revision for roads and bridges, began cleaning up the document and correcting bugs that were causing charts to fail, continue to fix bugs and work on the graph coding and the reduction of loading time, etc.; completed the September report and general project management.

Project's Financial Summary

October Expense Reimbursement Submitted	$3,135
Total Project Expense Reimbursements to Date	$3,135
Contract Balance Available	115,068